A QUANTITATIVE ANALYSIS OF STONE BUILDINGS AND ASSESSMENT OF THE MASONRY LABOR MARKET IN NEW YORK STATE

A Thesis

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Master of Arts

By

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ABSTRACT

This thesis demonstrates how quantitative analysis can be applied to the existing building stock and construction industry to provide detailed information about building condition and maintenance needs as well as the ability of the industry to meet these needs. It shows how this information can be used to inform planning activities for the historic built environment. To demonstrate this methodology and evaluate a perceived shortage of masons skilled in repair and restoration work, an assessment of the maintenance and repair needs of the stone building stock in New York State and the ability of the masonry labor force to meet these needs was undertaken.

Property tax assessment data were used to conduct an inventory and condition assessment of stone buildings in the state. Of the 2,668,649 buildings in New York State (excluding New York City), 13,639 are built using some form of stone construction. Of these, approximately 3,096 will require some degree of maintenance or repair intervention in the next twenty years.

A survey of masonry contracting firms working in the state was conducted to gauge the current and perceived future workload of the firms, their ability to recruit new entrants to their trade, and the age and skill competencies of respondents, as key indicators of the "health" of this subsector of the construction industry. Key findings indicate that, while existing workforce skill levels can be considered high, there are insufficient qualified workers to meet demand, the subsector has difficulty recruiting new entrants, and that an aging workforce may exacerbate current shortages. Recommendations for recruiting and training new workers are provided.

While limited in scope to stone masonry and confined geographically to New York, the methods presented in this thesis can provide a model for studies involving other building materials or localities. This information has relevance beyond the field of historic preservation, with direct applications for trades training programs, labor organizations, workforce planning and policy makers, and a variety of stakeholders concerned with the built environment.

BIOGRAPHICAL SKETCH

Prior to his graduate studies at Cornell, Edward FitzGerald studied history and cultural anthropology at Northern Illinois University, earning a Bachelor of Arts degree *magna cum laude* in 2006. At Cornell, his long-standing appreciation of historic architecture and interest in understanding the past through its material culture were brought together in the field of historic preservation. In the summer of 2007, FitzGerald was awarded an internship with the Scottish Stone Liaison Group in Scotland under the auspices of the US/ICOMOS International Exchange Program. This experience proved influential to his later research as he was exposed to efforts to coordinate the activities of heritage conservation authorities with building trades training programs and the quarry industry to preserve Scotland's rich stone built heritage.

Following the completion of his graduate coursework in 2008, FitzGerald worked first as an intern then later, as a research assistant and then, architectural conservator at the National Park Service's National Center for Preservation Technology and Training (NCPTT). There, he consulted on preservation projects across the United States, led studies on traditional building materials and conservation technologies, developed Preservapedia.org (a wiki for historic preservation), the National Building Stone Database (a physical collection and repository for technical information about the stones used in America's building and monuments), and a system for documenting cultural resources using mobile devices. He has subsequently given lectures on his work at NCPTT across the United States and abroad. FitzGerald currently works as an architectural conservator at Jablonski Building Conservation in New York City.

To Betty and James FitzGerald

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I am grateful to the Historic Preservation Planning Alumni who generously helped with some of the expenses associated with acquiring data for this research and to the masons who responded to the New York Masonry Labor and Skills Assessment Survey.

This thesis is directly influenced by the summer I spent in Scotland under the auspices of the US/ICOMOS International Exchange Program. I would like to thank the members of the program's selection committee, Historic Scotland for its financial support, and Colin Tennant and Jane Milroy, my gracious hosts at the Scottish Stone Liaison Group.

Last, but most certainly not least, a very special thanks is owed to my late grandparents, Betty and James FitzGerald, who funded my education and afforded me so many other wonderful opportunities. They taught me the value of thrift and resourcefulness, two principles that are indispensable in preserving old buildings and monuments.

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INTRODUCTION

Quantitative analysis can be applied to the existing building stock and construction industry to provide detailed information about building condition and maintenance needs as well as the ability of the industry to meet these needs. This information can be used to inform planning activities for the historic built environment. The following is an attempt to demonstrate the application of quantitative methodology to assess the maintenance and repair needs of the stone building stock in New York State and the ability of the masonry labor force to meet these needs. While limited in scope to stone masonry and confined geographically to New York, the methods presented here can provide a model for studies involving other materials or localities.

Background

Preserving buildings requires skilled tradespeople. Since the early days of the historic preservation movement in the United States, preservationists have observed a shortage of tradespeople skilled in historic building methods and contemporary preservation technology.[1] The problem continues to be observed through anecdotal reports.[2] However, few have attempted to quantify or study the issue in a systematic way.

In 2005, the National Heritage Training Group released a groundbreaking study providing the first ever large-scale analysis of traditional building craft skills and materials in England.[3] There, as in the

[1] One early statement of the problem, but by no means the earliest, can be found in the Whitehill Report; Walter Muir Whitehill, ed., "The Whitehill Report on Professional and Public Education for Historic Preservation," National Trust for Historic Preservation, April 1968, available at http://www.iptw.org/whitehill-home.htm

[2] This problem is often reported anecdotally and so, little documentation exists. For a basic introduction to the shortage of traditional building craftsmen see the articles in, Ronald M. Greenberg, ed., *Cultural Resource Magazine* 20, no. 12 (1997); and the papers and reports of the International Trades Education Symposium, Preservation Trades Network, "International Trades Education Symposium Papers and Reports on Traditional Trades Education," http://www.iptw.org/ites-paper.htm (accessed 25 February 2009).

[3] Under the leadership of John Fidler, the two English government bodies, English Heritage representing the heritage conservation sector and the Construction Industry Training Board (formerly "CITB," now "Construction Skills") representing the construction industry, formed a partnership to assess and address a perceived "shortage"

US, practitioners in the historic preservation industry had been lamenting a perceived deficit since the 1960s of tradespeople with the requisite skills to preserve historic buildings and monuments. The novelty of the NHTG approach is that it sought to analyze the problem using quantitative means. A variety of data sources were used, but the primary dataset came from surveys administered to 1,567 building owners, trades contractors, training providers, and others whose work involved historic buildings. The study analyzed and quantified supply and demand in the sector, identified specific skills shortages, and assessed current training provisions and the supply chain of traditional building materials. As a result, industry planners were able to approach the problem in an informed and strategic way. The study was so successful that it has subsequently been expanded and repeated in England and reproduced in the rest of the United Kingdom and in Ireland.

Another such study aimed at addressing the needs of the historic built environment was conducted in Glasgow, Scotland in 2005-2006.[4] The Glasgow study was undertaken by the Scottish Stone Liaison Group to provide data on the quantity of replacement building stone needed and the amount of time and skill levels required of stone masons for the repair and maintenance of the stone built heritage of the city. Teams surveyed the facades of over 230 traditional stone buildings and monuments to assess the amount, type, and severity of stone decay. To do this, a methodology was developed which involved the use of rectified digital images annotated with measurable condition information. The survey teams then consulted with masons to calculate the quantities of labor and

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of traditional building craft skills; their novel research in this area is presented in, National Heritage Training Group, National Heritage Training Group, *Traditional Building Craft Skills—Assessing the Need, Meeting the Challenge: Skills Needs Analysis of the Built Heritage Sector in England 2005* (London: National Heritage Training Group, 2005); this analysis has since been replicated in Scotland, Ireland, and Wales and has served as the basis for similar studies in other Commonwealth countries.

[4] Dennis Urquhart, et al., *Safeguarding Glasgow's Stone-built Heritage: Skills and Materials Requirements* (Edinburgh: Scottish Stone Liaison Group, 2006). For documentation of the methodology employed in this study see, Dennis Urquhart, *Stonemasonry Skills and Materials: A Methodology to Survey Sandstone Building Façades,* Technical Advice Note 31 (Edinburgh: Historic Scotland, 2007).

materials required for repairs. A particularly novel aspect of this study is that it produced projections that addressed not only the immediate needs of the historic stone building stock, but how those needs might grow over the next twenty years.

The English and Scottish studies represent two different quantitative methods of approaching planning issues for the historic built environment. In England, researchers focused on the market, collecting data directly from trade practitioners and basing their projections on perceived demand and deficiencies reported by the workforce. In Scotland, research focused on the observed repair and maintenance needs of a sample of buildings, estimating needs and extrapolating this data to the larger building stock. Both studies are innovative in that they approach their respective topics in a broad way, taking up markets and the building stock as research objects rather than focus piecemeal on individual buildings or the needs of a particular construction project. Indeed, this broad-based approach is necessary to address the training and resource planning issues that underlie symptoms such as shortages of skilled labor or appropriate materials. Another key aspect of these studies is that they are longsighted, looking not just at the problem that presents itself today but also problems that will manifest over time. Buildings deteriorate with age. Workers grow old and retire. Skilled tradespeople take time to train. These factors must be taken into account in order to devise long-term, sustainable solutions.

The English and Scottish studies mentioned here provide empirical models that offer the domestic historic preservation industry a proven methodology through which to understand and address perceived labor and materials supply issues. These studies, now a decade old, have yet to see their counterpart in the United States. While the UK is undeniably smaller than the US and has its own distinct built heritage, building trades traditions, and heritage institutions, these differences do not preclude the studies discussed above from being adapted and used as models to address similar issues

in the US. This study aims, in part, to demonstrate the relevancy of methods pioneered aboard to the United States.

Methodology

This study makes use of property tax assessment records and survey data. The analysis of each of these datasets could constitute its own separate study. However, they are brought together under this thesis in order to help form a comprehensive picture of supply and demand within the construction and construction labor markets. As the studies discussed above demonstrate, these markets can studied from multiple angles: The maintenance and repair needs of the building stock can be understood by examining its condition. These needs in turn create demand for maintenance and repair work (though it should be noted that the correlation between the two is not direct and that *need* does not necessarily result in *demand*). Demand within the market can be studied by examining the current and future perceived workload of firms providing repair and maintenance services. Their ability to meet demand informs our understanding of the supply side of the market. At yet another level, the firms' capacity to tender projects is related to the supply of labor and materials, which are in turn dependent upon training and materials production capacities. A nexus research approach, i.e. that taken here, examines each of these angles in order to develop a comprehensive understanding of the market (Figure 1).

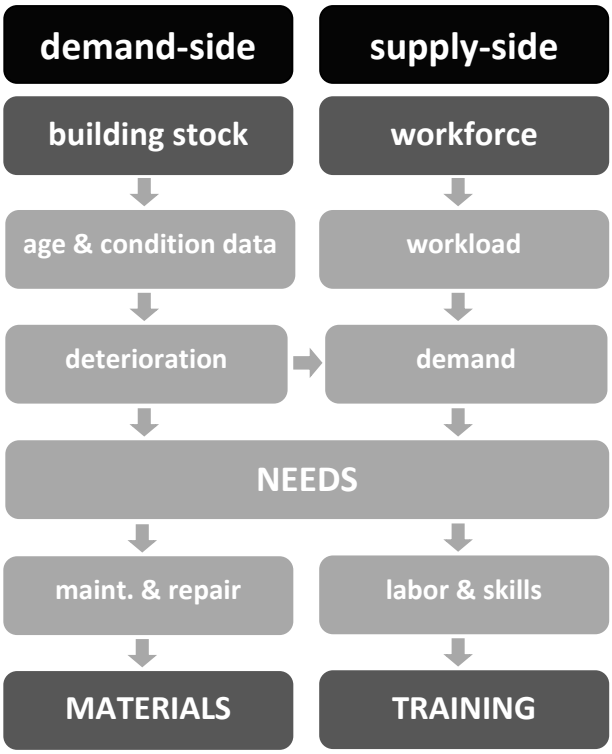

Figure 1. Nexus market assessment model.

Because of the disparate nature of the two datasets employed in this study, a detailed description of the research methodology used for each is reserved for the chapter in which they are discussed. Chapter 1 contains an inventory and condition assessment of the stone building stock in New York State. This chapter informs our understanding of the size and other important characteristics of the stone buildings stock and establishes its maintenance and repair needs. Chapter 2 contains an analysis of data collected from firms engaged in the repair and restoration of historic masonry buildings. This chapter is primarily concerned with the supply side of the construction market, however, demand is also addressed in the form of current and future perceived workload. Two factors affecting firms' ability to meet demand, the supply of skilled labor and specialized materials, are also addressed.

Scope and Delimitations

The scope of this thesis extends slightly beyond the limits of what is typically considered historic preservation. While the distinction between the building stock and that portion of which is considered historic may be clear to preservation professionals, the difference may not be so apparent when considering economic activities in the construction industry at large. As the data presented in Chapter 3 will show, some firms engage in work on new buildings as well as old. For the purposes of discussion, the portion of the masonry sector of the construction industry engaged in the repair and restoration of masonry buildings (regardless of age or historic value) has been termed here the *repair and restoration (R&R) subsector.* This terminology may give the impression that the R&R subsector is a distinct entity within the construction industry as a whole. However, the day-to-day reality is that many masonry contracting firms engage in a broad range of work that cannot be rigidly classified by any one descriptor.

This thesis considers all existing stone buildings rather than only those deemed historic. In the United States, the generally accepted age threshold for a building to be officially designated "historic" is 50 years old or older.[5] The data presented in Chapter 2 could be filtered to limit the age of buildings studied to within this range. However, masonry firms would not likely turn down work on the basis of the building's age and so, it was deemed prudent to incorporate as much of the stone building stock as possible into this study. This doubtless means the inclusion of many buildings constructed using modern materials and methods such as thin-stone veneer. While the purist might debate whether to classify these constructions as stone masonry, they nevertheless fall under the purview of masonry firms conducting maintenance and repair work.

The geographic focus of this study, New York State, was chosen because of the availability of data and because the state has a large stone building stock. Stone buildings were selected as the subject

[5] The 50-year age threshold is codified in the eligibility criteria for the National Register of Historic Places. "Criteria for Evaluation," *Code of Federal Regulations*, title 36, part 60, sec. 4 (2006).

of this study for a variety of reasons. A significant proportion of buildings deemed historically significant are built in stone. The material projects a sense of permanence and prestige, accounting in part for its popular use in banks, churches, monuments, and public buildings—building types to which we often ascribe historic value. Because of its natural durability, appropriately selected stone is inherently able to resist weathering and other forms of deterioration and so, stone buildings can survive a long time.

Yet, like all materials, stone does ultimately deteriorate. When this occurs, certain specialized skills and an awareness of or sensitivity to historic significance are required to execute appropriate maintenance and repairs. Among professionals working in the field of historic preservation, there is a perception that these skills and sensitivity to historic fabric are not common among the masons and other tradespeople called upon to make needed repairs. Furthermore, these professionals often perceive a shortage of workers that do possess the requisite skills. These anecdotal observations provided the basis for the second half of this study, which attempts to empirically assess the ability of the masonry workforce to meet current and projected demand for the maintenance and repair of the stone building stock.

Summary

The chapters that follow attempt to demonstrate the application of quantitative methodology to assess the maintenance and repair needs of the stone building stock in New York State and the ability of the masonry labor force to meet these needs. They proceed with Chapter 2 which describes the steps undertaken to conduct an inventory and assess the condition of the state's stone building stock using tax assessment data. The resulting data are presented and used to estimate and forecast the maintenance and repair needs of the building stock. Chapter 3 presents the results of a survey of masonry contracting firms working in the state. The survey data attempt to gauge the current and perceived future workload of the firms, their ability to recruit new entrants to their trade, and the age and skill competencies of respondents, as key indicators of the “health” of the R&R subsector. The

Conclusion summarizes key observations drawn from the primary research presented in the previous chapters and includes recommendations for further research.

1 BUILDING STOCK INVENTORY

An accurate physical inventory of the stone building stock is a perquisite to understanding its condition. Inventory data including size, age, and condition of the building stock can be used to infer and quantify repair needs. Unfortunately, no readily available source for this data exists. There is no national inventory of the built environment.[6] While micro-scale data from the national census[7] comes close—reporting on the quality, age, energy-related characteristics, and infrastructure of existing buildings—no uniform record of building material is kept. National, state, or local records of historic properties[8] document only a small proportion of stone built resources—those buildings deemed culturally significant. Other potential data sources concerned with the built environment do not contain data sufficient to derive either building material or condition. Thus, some degree of resourcefulness is required to obtain this information.

This chapter describes the steps undertaken to conduct an inventory of stone buildings in New York State. The data sources section provides a review of data sources considered for this study, the criteria used in selecting a source, and a discussion of why, ultimately, tax assessment records were selected. The methodology section describes how tax assessment data were obtained and processed for use in the inventory and assessment of the stone building stock. The results and discussion section

[6] This is not the case in many European countries. In recent years, concern over building energy performance has led to the creation of several publically accessible databases containing a wealth of detailed building attribute data, including building typology, envelope/envelope materials, and age. Examples include the Buildings Performance Institute Europe's Data Hub, http://www.buildingsdata.eu/ (accessed 5 March 2016), and Intelligent Energy Europe's TABULA Web Tool, http://webtool.building-typology.eu/ (accessed 5 March 2016).

[7] The American Housing Survey (AHS) from the U.S. Department of Housing and Urban Development samples approximately 55,000 units annually and provides some useful indicators of housing characteristics but, is primarily concerned with the standard of living conditions within the residential building stock. The Department of Energy's Commercial Buildings Energy Consumption Survey (CBECS), which profiles energy-related building characteristics, offers data on floor space, lighting, and heating and cooling equipment but neglects building fabric as a factor in energy consumption. For more on these data series, see http://www.huduser.org/DATASETS/ahs.html and http://www.eia.doe.gov/emeu/cbecs/ (accessed 23 October 2008).

[8] U.S. Department of the Interior, "National Register Information System" (Washington, DC: National Park Service),available at http://www.nr.nps.gov/NRISDATA (accessed 17 July 2008).

combines reporting and interpretation of tax assessment data, focusing particularly on the reported age and condition of buildings to facilitate the estimation of the future repair and maintenance needs of the stone building stock contained in the following section. The final section in this chapter discusses the significance of obtained results and provides recommendations for further research.

1.1 Data Sources Review

Four sources of data characterizing the stone building stock in New York State were considered for this study. These included analysis of aerial photographs, Sanborn fire insurance maps, direct statistical sampling, and county tax assessment rolls.[9] In order to achieve the stated aims of the study, it was determined that the optimal data source would provide: 1) an accurate count of the total population of buildings in the State of New York built using stone as a primary construction material or, sufficient data to constitute a representative sample of the stone built environment within the geographical boundaries of the state, 2) a way to determine the geographic distribution of buildings within the defined boundaries and, 3) a means by which to characterize the condition of the population of buildings under study. While, in any of the four data sources considered, field sampling would provide the most accurate characterization of building condition, it was determined that age, in conjunction with an estimate of material durability and deterioration over time, could functionally substitute for real observed condition data. While a more in-depth study might also account for variations in local conditions such as pollution levels, precipitation, temperature, etc., this was deemed unnecessary for the sort of bulk condition characterization needed here.

[9] While this study focused on prediction of building attributes, high-quality sources of actual building data, especially for use within GIS, were also of interest. In recent years, building inventories have become available in digital form. Several companies, such as I-Cubed, ISTAR, Urban Data Solutions, Marconi, and the Google Earth project produce digital vector and/or raster "buildings" that can be quite faithful to their real-world counterparts. These buildings, created typically by traditional photogrammetric techniques, are often accompanied by additional data, such as one or more digital elevation models, and 3-D digital models are currently available for several U.S. cities.

1.1.1 Aerial Analysis

Two studies produced by the Institute for Social and Economic Research at Cornell University in the 1980s explored the use of aerial photography in estimating building stocks for the purpose of earthquake mitigation and recovery planning.[10] Estimates of the number, purpose, and structural attributes of built resources were made using large-scale aerial photography, USGS 7.5' Quadrangle maps, and tax assessor data and were calibrated through sampling. Structural attributes (e.g. height, material, structural system, etc.) were inferred as average characteristics belonging to buildings of a particular occupancy class. These studies demonstrate that empirical regularities characterize the distribution of buildings over categories and by categories over space.[11] This relationship confirms the feasibility of models of the building stock that map the relationship between the number of buildings in a geographic area and their users and uses. Such models relying on the inference of detailed building attributes are, however, unlikely to permit the estimation of parameters with any great precision.[12]

Subsequent studies have continued to explore the use of aerial imagery for disaster mitigation. Developments in infrared sensing and digital photogrammetry technologies have expanded the possibilities and application of data collected from the air.[13] However, analysis of aerial survey data has

[10] Barclay G. Jones, et. al, "Estimating Building Stocks and Their Characteristics." Institute for Social and Economic Research, Program in Urban and Regional Studies, Cornell University, Ithaca, NY, 1987; Kimberley A. Johnson,. "An Investigation into Estimation of Building Stocks Through Sampling of Aerial Photography," *Working Papers: Estimating Building Stocks for Earthquake Mitigation and Recovery Planning*. Institute for Social and Economic Research, Program in Urban and Regional Studies, Cornell University, Ithaca, NY, 1986.

[11] Jones, "Estimating Building Stocks," 17-19.

[12] Johnson, "Investigation into Estimation," 128.

[13] See Keiko Saito, et al., "Using High-Resolution Satellite Images for Post-Earthquake Building Damage Assessment: A Study Following the 26 January 2001 Gujarat Earthquake," *Earthquake Spectra* 20, no. 1 (February 2004): 145-169; John R. Schott, "Quantitative Aerial Survey of Building Heat Loss," *Thermal Infrared Sensing Diagnostics (Thermosense IV)*, *SPIE Proceedings*, vol. 371, ed. G.E. Courville, 187 (Bellingham, WA: Society for Photo-Optical Instrumentation Engineers, 1982); M. Gerke, et al., "Building Extraction from Aerial Imagery Using a Generic Scene Model and Invariant Geometric Moments," in *Proceedings of the IEEE/ISPRS Joint Workshop on Remote Sensing and Data Fusion over Urban Areas,* p. 85-89 (Rome: IEEE, 2001).

yet to prove capable of accurately determining either building material or condition and so, for the purposes of this study, is inadequate.

1.1.2 Sanborn Maps

Sanborn Maps, produced for insurance assessment purposes between 1867 and 1970, offer a valuable resource for historians, geographers, urban planners, and preservationists.[14] Among the many geospatial and demographic specifics one can glean from these maps is textual information regarding construction details and, on some later maps, color shading indicating different building materials. While more than 660,000 maps of over 12,000 American towns and cities are readily available in digital form, this is both advantageous and problematic.[15] Unless the process was facilitated by digital image analysis software, manual visual analysis of these maps would likely prove time-consuming. Further, the data obtained would only cover urban areas and buildings that were constructed before 1970. Though the Sanborn Company is still in operation, there is no simple way to cross-check historical maps with more recent records, and so, no way of determining whether the buildings shown still exist.[16] While too problematic for use in studies where the most current information is necessary, the relatively unexplored building material data locked in these maps presents promise for future research on historical trends in building materials, construction, distribution, etc.

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[14] See Richard Harris, "Reading Sanborns for the Spoor of the Owner-Builder, 1890s-1950s," in *Exploring Everyday Landscapes: Perspectives in Vernacular Architecture* 7, eds. Annmarie Adams and Sally McMurry, 251-267 (Knoxville: University of Tennessee Press, 1997); Diane L. Oswald, *Fire Insurance Maps: Their History and Applications* (College Station: Lacewing Press, 1997); Robert L. Wrigley, Jr., "The Sanborn Map as a Source of Land Use Information for City Planning," *Land Economics* 25, no. 2 (May 1949): 216-219.

[15] University of Maryland, University Libraries, "A Brief History of the Sanborn Fire Insurance Maps and the Sanborn Map Company," http://www.lib.umd.edu/NTL/Sanbornhistory.html (accessed 15 September 2009).

[16] The Sanborn Company's historic map collection was acquired by Environmental Data Resources, Inc. in 1996, which now offers digital reproductions of the original maps as well as the Sanborn Viewer application which overlays historic Sanborn maps on Google Maps high-resolution aerial imagery.

1.1.3 Statistical Sampling

Statistical sampling of the building stock *in situ* offers the most advantageous method of estimating both building material and repair needs. This was shown to be the case in the Glasgow Project discussed above.[17] The primary benefits of sampling are that weathering and other in-use conditions are directly observable and that the results are scalable. Measurements may be taken from actual buildings at full scale, making it possible, for instance, to assess the influence of adjoining materials or to gain immediate data on long-term in-use behavior; and it is possible to sample as many structures as economy allows. A representative sample of a particular population of buildings can be determined using public records and a detailed condition analysis of this sample can be carried out and extrapolated to characterize a large population with a considerable degree of accuracy. The model can then be calibrated to minimize the margin of error using statistical methods.

While sampling possesses the benefits of both scale and ability to capture detailed attributes and genuine condition data, there are some potentially significant drawbacks to relying solely on the collection of data in the field. While not essential for the purposes of this study, it can be difficult to track the history of the materials being studied or to measure and describe the in-use environmental conditions. Sufficient records of building or repair campaigns, actual exposure conditions, and other data required for the study of sites over time may be difficult to locate. Further, destructive tests or access to sites is dependent upon the consent of owners. A considerable disadvantage of sampling, and the one negating its use in this study, is the amount of money and man power needed to survey the

[17] A stratified random sample was used in the Glasgow Project which grouped stone buildings by 1) building type (i.e.. residential mixed use, residential detached, etc., religious, public, commercial, industrial, monuments), 2) age (i.e. pre 1800, 1800-1850, 1850-191, post 1919) and, 3) stone type (e.g. re or blond sandstone); sample size was calculated in proportion to the relative size of the strata; to avoid any tendency to focus on stonework in the poorest condition, the sample was composed of buildings from each stratum selected at random; Urquhart, *Safeguarding Glasgow*, 1-14.

number of sites necessary to obtain statistically significant results.[18] Nevertheless, future large-scale studies of repair needs would do well to adopt some method of statistical modeling based on a representative sample of the population under study.

1.1.4 Tax Assessment Records

While each of the methods considered above have their advantages, the approach adopted to inventory the stone building stock for this study relied upon the rich and readily available data contained within New York State's property tax assessor rolls. Municipalities and counties typically keep detailed records of ownership and the attributes that affect the value of a particular tax parcel. In some cases, assessments may include subjective data such as the quality of construction, present condition, and even the style of architecture. The level of detail collected varies by locality. While tax records may not be useful everywhere, when they are available and register sufficiently detailed attributes, they generally constitute a reliable means by which to inventory and study certain characteristics of the building stock.[19] Assessments are required by law to be conducted in a uniform manner and the standards by which properties are evaluated must be made publically available (these are often contained within an assessor's manual).[20] Thus, the researcher can theoretically deconstruct the data collection methodology and expect some degree of consistency across records collected within an assessor's province.

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[18] For Westchester County, which has the highest population of stone buildings of any county in the state, a minimum of 325 of the county's 2,099 stone buildings would have to be sampled to achieve a statistical confidence level of 95% (where the margin of error = ±5%).

[19] Researchers in the UK have used tax assessment records in conjunction with several other data sources to build a database of non-domestic buildings and make inferences about form, construction, and fabric from which to study the greenhouse gas emissions from the UK's building stock; see P. Steadman, H.R. Bruhns, and P.A. Rickaby, "An introduction to the national Non-Domestic Building Stock database" *Environment and Planning B: Planning and Design* 27, no. 1 (2000): 3-10.

[20] "Real Property Tax," *New York State Consolidated Laws*, Article 5, Sect. 500, available at http://public.leginfo.state.ny.us

There are also, however, some potential problems with using tax assessment records. Depending on the geographic scope of the study, researchers may encounter inconsistencies in the systems in use from place to place. Further, all records from several different taxation areas may not be conveniently accessible from a single, centralized location. In New York State, for instance, key attributes are uniformly collected by all counties and centrally available (with the exception of those administered by the New York City Department of Finance) through the state Office of Real Property Services (ORPS) Real Property System database (RPS). However, some data (e.g. property condition) are not collected in certain counties and so, these fields are not uniformly populated in the statewide RPS database. Actual data from the RPS also illustrate another potential shortfall: that tax assessors are not always trained or equipped to evaluate structural building elements or material conditions as would an architect, conservator, or engineer. The criteria for subjective evaluations and the data from which are derived (e.g. quality of construction, condition of structure, architectural style, etc.) must be subjected to additional scrutiny to ensure their validity.

Tax assessment records present another potential problem in that they may not include data on tax-exempt properties such as religious or government-owned structures. Depending on the aims of a particular study, this inherent information gap can prove limiting and supplemental sources of data may be needed. Studies of stone built resources, in particular, are susceptible to such gaps. Since stone has frequently been used in the construction of schools, churches, and government buildings, inclusion of such properties in the selected data source would be imperative. In addition, tax records—like any government record for that matter—inevitably fall subject to laws protecting privacy and sensitive information and so researchers may have difficulty accessing the desired information. Yet, if these hurdles can be overcome, tax assessment records hold excellent potential for researchers concerned with the built environment.

Fortunately, few of the issues noted above were encountered in data collected for the purposes of this study. The New York State ORPS database, RPS, is rich with pertinent information—including non-taxable religious and government-owned buildings and an array of detailed building attributes—is relatively unflawed by the inconsistencies or gaps that may occur in assessment data, and most of the data it contains are available to researchers upon request. It therefore proved to be a suitable data source for this study. Its greatest limitation is that it does not include properties located within the five boroughs that make up New York City.

1.2 Methodology

Acquisition of data for the inventory of New York's stone building stock began by identifying the information available through the RPS and selecting the appropriate fields necessary to determine count, distribution, use, and condition of the defined population.[21] These selected database fields, procured through a New York State Freedom of Information Law (FOIL) request, are shown in Table 1. The abstracted tables contained 2,668,649 unique records (2,409,854 residential and 258,795 non-residential), for fifty-seven counties.[22] The five boroughs of New York City (including Bronx, Kings, New York, Queens, and Richmond Counties) were not available through the ORPS since these tax units are administered by a separate agency, the New York City Department of Finance. Attempts to procure data from this agency were unsuccessful and so, regrettably, a large number of the state's stone buildings are omitted from this study.

[21] The ORPS Assessor's Manual was invaluable in deciphering both the data contained in the RPS fields and the methodology used in their collection; New York State Office of Real Property Services, "Assessor's Manual: Data Collection and Maintenance of Property Inventories," New York State Office of Real Property Services (Albany: NYS ORPS, 2001).

[22] New York State Office of Real Property Services, Real Property System database (data queried 2 May 2008).

Table 1. Selected Real Property System fields from RES_BLDG and COMM_IND_UTL_BLDG tables (incomplete/unusable fields demarcated in gray).

	Column name	Column definition
Common	PARCEL_ID	Parcel ID is an internal id number used in the application to denote a specific parcel.
	SITE_NBR	Site Number records the site being inventoried.
	SWIS	Swis Code records the six digit number established by the state, which identifies the count, city/town and, if applicable, village/town-outside-village in which the parcel is situated.
	YR_BUILT	Year Built records the actual year in which the building was constructed.
	EFF_YEAR_BULT	Effective Year Built records the effective age of a building on the site. Typically, the effective age is determined by comparing the physical condition of one building with that of other like-use newer buildings.
Non-Residential	BOECK_NBR	Model Number records a four-digit code representing a pre-defined model available in the Boeckh Cost System used by ORPS.
	CONSTR_QUALITY	Construction Quality records the construction quality of the building based on an analysis of common characteristics in a majority of buildings in an occupancy type.
	WALL_A_PCT	Wall Percent records the exterior wall material which most closely reflects the structure. For each model there are three exterior wall categories available: A, B and C. An amount totaling 100% must be entered.
	WALL_B_PCT	
	WALL_C_PCT	
	COND_CODE	Condition records the physical condition of the interior and exterior of the building section.
Residential	BLDG_STYLE	Building Style is used to classify the architectural style of the residence.
	GRADE	Building Grade records the overall construction grade and quality of workmanship found in the residence.
	EXT_WALL_MATERIAL	Exterior Wall records the predominant facing material used in the construction of the exterior walls.
	OVERALL_COND	Overall Condition records the overall physical condition of the inside and the outside of the residence.
	EXTERIOR_COND	Exterior Condition records the overall physical condition of the exterior of the residence.

The subsections which follow describe the data obtained from the ORPS database and explain the application and utility of each of the field sets shown in Table 1. The sequence begins by describing the organization of records by “building use” as inherited from the ORPS (Section 1.2.1) and continues

with the filtering of records to include only those for the building material under study (Sect. 1.2.2). Data related to building condition (Sect. 1.2.3) and age (Sect. 1.2.4) are then discussed. Finally, additional fields that were not obtained from the ORPS FOIL request, but that may have proven helpful in characterizing the building stock, are discussed in Section 1.2.5.

1.2.1 Building Use

A building's function or use provides a convenient way to organize built environment data. The ORPS organizes its records of real property into two datasets: one for residential buildings and another for non-residential[23] buildings. Included in the non-residential dataset are commercial properties and those not subject to taxation (i.e. religious and government-owned property). The ORPS employs a classification scheme for non-residential property records known as the Boeckh Cost System.[24] This system correlates building form and material with certain predetermined non-residential uses, allowing multiple attributes to be defined as a numeric code (discussed further in Section 1.2.2 below). Using the Boeckh code for a given property record, it is possible to differentiate between types of non-residential use. Non-residential buildings were thus separated by use as public (i.e. government-owned), religious, lodging, office, mercantile, recreation, bank, and health care facility.

1.2.2 Building Material

To confine the records to the building material defined in the parameters of this study, data from the RPS were filtered by the EXT_WALL_MATERIAL (residential) and WALL_A, B, or C_PCT (non-residential) fields to limit the dataset to those structures whose primary exterior wall material is stone.

[23] The ORPS actually uses the term *commercial* to describe all non-residential properties in its database; this includes religious and public buildings—uses that typically would not fall under the traditional definition of *commercial*—as well as those used for some for-profit purpose (e.g. banks, offices, lodging, etc.). In order to avoid confusion and to provide a more accurate description of their use, these properties are here termed *non-residential* and the traditional definition of *commercial* as pertaining to for-profit business activities stands.

[24] As far as the author is aware, the ORPS is the only state tax assessor to use this system to inventory real property.

While this process was fairly straight forward in the residential table which included a specific category for stone (coded as material type 7),[25] the categories prescribed by the ORPS inventory system for non-residential buildings made filtering for stone buildings alone more complicated.

The ORPS uses a four-digit code representing a pre-defined Boeck Cost System "model" to describe the use, type, construction, and materials of the non-residential buildings and structures that it inventories. These codes cross-reference building use (e.g. lodging, offices, mercantile, etc.) with common design configurations (e.g. "shopping center-strip type, 1 story, load-supporting walls") and then classify the exterior wall construction type by thirteen categories ranging from least to most expensive (see excerpted example in Figure 2). After determining the most suitable Boeckh model, the assessor is then supposed to record the percentage of a given wall construction category (A, B, and C) indicated by the appropriate model number. So for example, for a one-story wooden office building, Boeckh model 0211 in Figure 2 below, the assessor would record the percentage of the building with A-wood siding or stucco on studs, B-concrete block, and/or C-brick on studs.

[25] Only one municipality, White Plains in Westchester Co., uses a different, more detailed, coding system, the particulars of which were procured through the city's tax assessment office.

OFFICES LEAST EXPENSIVE TO MOST EXPENSIVE

Exterior Wall Category
Cross-Reference Table

MODEL NUMBER & DESCRIPTION		AVERAGE STORY HEIGHT	WOOD SIDING OR STUCCO ON STUDS	TILT-UP CONCRETE PANELS	RIBBED METAL SIDING	CONCRETE BLOCK	INSULATED METAL PANELS	BRICK ON STUDS	REINFORCED CONCRETE	BRICK WITH BLOCK BACKUP	PRECAST CONCRETE PANELS	COMMON BRICK	GLASS CURTAIN WALL	STONE WITH BLOCK BACKUP	STONE WITH BRICK BACKUP
0211	Office, 1 Story, Wood	10	A			B		C							
0212	Office, 1 Story, Load Supporting Walls, Posts & Beams	12		A		B				C					
0213	Office, 1 Story, Pre-engineered	12			A		B			C					
0214	Office, 1 Story, Steel	12				A				B				C	

Figure 2. Boeckh Cost System Models, excerpt from ORPS, "Assessor's Manual," sect. APP-A.

This system can be confusing and limits the research potential of the data it characterizes since the model descriptions and structural categories are primarily oriented toward modern construction systems and all buildings must conform to the predefined models. There is, for instance, no Boeckh model number for a free-standing office building with post and beam framing and stone load bearing walls. While several models come close none would suitably describe such a building. For structures that do not conform to the Boeckh model, assessors are instructed to record the wall material which most closely reflects the structure.[26]

The Boeckh model has limited options for wall assembly details. Only two categories for stone construction are given, "stone with block back-up" and "stone with brick back-up", but no option exists for those structures where only stone is used in supporting walls (see Figure 2). So, according to RPS records, all of New York's stone built environment is constructed as stone facing. However, cross comparison with the records of the NY State Historic Preservation Office indicate that some taxable and

[26] ORPS, "Assessor's Manual."

non-taxable properties within the state indeed include solid, load-bearing stone walls.[27] Because of these limitations, we cannot ascertain exactly how stone is used in exterior wall assemblies from the RPS construction material data alone.[28]

Records from the RPS dataset were filtered based on the assumption that assessors categorized any form of stone masonry construction by its most suitable description (i.e. within the two available categories). All Boeckh models where stone is indicated as an exterior wall category are included in the following analysis.[29] However, given the complexity of the Boeckh system and the degree of subjective judgment required to select a model number which may only partially characterize a structure, it seems possible that some records may have been given model numbers that are inconsistent with the prescribed system. To ensure that stone is actually the most prevalent material in the building records that were identified, the non-residential table was filtered to include all records where WALL_C_PCT is greater than 49% (e.g. Model Number 214: Office, 1 story with 0% concrete block, 30% brick with block, and 70% stone with block exterior walls).

1.2.3 Condition

Using certain data fields available in the RPS, it is possible to gain some understanding of the general state of repair of buildings in New York. Unfortunately, the two fields best suited to the characterization of exterior wall condition, EFF_YR_BLT (i.e. "effective year built", discussed further

[27] New York State Historic Preservation Office, "State and National Registers of Historic Places Document Imaging Project," http://www.oprhp.state.ny.us/hpimaging/ (database queried 16 September 2009).

[28] It may be possible to further filter the dataset for solid, load-bearing stone construction by the date of construction; Stone veneer did not become a prominent building material in the U.S. until the early twentieth century so, one could logically assume that most stone buildings built before this time are of load-bearing construction. However, such an assumption would disregard those solid stone buildings of a more recent vintage. Michael J. Scheffler and Edward A Gerns, "Thin Stone Veneer," in *Twentieth-Century Building Materials*, ed. Thomas C. Jester, 164-173 (Washington, DC: McGraw-Hill, 1995).

[29] The following Boeckh models indicate stone as an exterior wall category; thus, records so cataloged were included in the filtered dataset: 142, 144, 163, 164, 214, 221, 314, 338, 453, 515, 521, 522, 524, 531, 545, 612, 613, 615, 641, 642, 643, 644, 666, 669, 670, 672, 676, 678-680, 647, 747.

below) and, for residential properties only, EXT_COND (i.e. “exterior condition”), were found to be inconsistently populated and so, were excluded from further analysis (see fields marked in gray in Table 1). While this eliminated data that would likely have been useful, the setback proved to be only a moderate one. Other fields—non-residential COND_CODE (i.e. “condition code”) and residential OVERALL_COND (i.e. “overall condition”)—provided usable condition data, although, at some cost to accuracy since these fields record the physical condition of both the interior and exterior of the building.

Counts for both COND_CODE and OVERALL_COND were tabulated from the filtered datasets to provide a characterization of the general condition of stone buildings.[30] Abstract tables for this data were prepared for all residential and non-residential properties and cross tabulated to show the distribution of condition rankings by county and year of construction. The ORPS rates the condition of the interior and exterior on a five point scale, defined in the Assessor’s Manual as: [31]

1. **Poor:** The building is approaching unsound condition with obvious signs of deterioration due to deferred maintenance over a long period of time. The building, or certain portions, may be unsuitable for occupancy.

2. **Fair:** The building shows signs of deferred maintenance relative to its age, but the property is still usable. It requires greater than normal maintenance or repairs to restore it to normal condition. The building may be occupied by a use other than originally intended. Newer buildings are sometimes found in this condition as a result of deferred maintenance, heavy weathering, or structural damage. Old buildings in this condition would require at least partial renovation to restore them to normal condition.

3. **Normal:** The building shows normal signs of wear and tear for its age and there are few signs of deferred maintenance or structural damage. Old buildings will appear suitable for occupancy or are usable commercially, even though the building style and features (such as doors and windows) may be outdated.

4. **Good:** The building shows no sign of weathering for its age due to greater than normal maintenance, or partial renovation. The building is still used as originally intended and the services are proper and adequate. Older homes may have undergone major remodeling.

5. **Excellent:** This indicates the building is in “like new” condition, shows no evidence of physical deterioration, is occupied by the use for which it was originally intended, and the building

[30] COND_CODE and OVERALL_COND data were missing in only 23 of the 13242 records.

[31] ORPS, “Assessor’s Manual,” sect. 8, 48-49 and sect. 9, 18.

services are modern, proper, and adequate. Major renovation may qualify a building for this classification.

1.2.4 Age

In addition to the overall condition, data indicating the age of stone structures in the RPS dataset also provides a means by which to characterize the magnitude (but not the quantity) of possible repair work. The RPS contains two data fields indicating age: YR_BLT records the actual year in which a structure was built and EFF_YR_BLT records the calculated "effective age" of the building on site. Effective age, which incorporates the estimated remaining life of the building and the economic life or service life of the building, is typically determined by comparing the physical condition of one building with that of other like-use newer buildings.[32] This calculation may or may not reflect the actual chronological age, since maintenance, remodeling, and design are factors that may increase or decrease "effective" age. While the calculated effective age would likely have provided useful data, it is a fairly recent addition to the state's inventory system and so, was not uniformly available. The RPS data for this field had to be omitted. However, an alternative method of calculating effective age was executed for this study and is included in the discussion of results in Section 1.4.1 below.

Records for the actual year in which a structure was built are available in most cases. This data must, however, be used with discretion since the collection methodology suggested in the Assessor's Manual allows for the year to be estimated when the actual date is unknown.[33] Inspection of the data in the YR_BLT field suggests that some of the dates may have been rounded to the nearest decade or century. An inordinately high number of buildings are recorded as having been constructed in the years 1800 and 1900 (i.e. 1801-1899) while relatively fewer are distributed throughout the intermediate century and still fewer throughout the intermediate decades (e.g. 1801-1809) (see Figure 7, p. 31).

[32] ORPS, "Assessor's Manual," sect. 9, 12.

[33] Ibid.

While the distribution of this data calls into question its accuracy, approximations (even if rounded to the nearest decade) are sufficient for the purposes of this study. The year of construction could conceivably be further narrowed by data indicating the architectural style of the structure contained in the BLDG_STYLE (i.e. "building style", e.g. Cape Cod, Colonial, Bungalow, Ranch, etc.) field. This extra step, which would require confidence in the assessor's knowledge of architectural terminology, was not taken here though.

1.2.5 Other Data

In retrospect, it would have been advantageous to have requested available fields containing data on building dimensions (perimeter and height) to determine the possible amount of wall surface area in need of repair. The implications of this oversight are, however, minimal since it would not have been possible to correlate age and condition with the deteriorated surface area without field sampling, and this, as has been mentioned, is beyond the capacity of this study.

1.3 Results and Discussion

Of the 2,668,649 non-residential and residential buildings in New York State recorded in the RPS database in 2007, 13,639 are built using some form of stone masonry construction.[34] Of these, 12,097 (88.7%) are used for residential purposes and 1,542 (11.3%) have a non-residential use. In comparison with other building materials, the proportion of stone buildings represents less than 1% of the total population of buildings in the state (see

Figure 3 for tabulated proportion of residential population). The most common exterior wall materials (82% of residential construction), including, wood, aluminum, and vinyl siding, are also the least expensive. In the 2008 construction market, hardboard lap siding costs approximately $2.20 per

[34] Excluding the five boroughs that constitute New York City as noted above.

square foot, aluminum $3.72 per square foot, and vinyl $1.89 per square foot, while large rough-cut limestone blocks cost approximately $50 per cubic foot.[35]

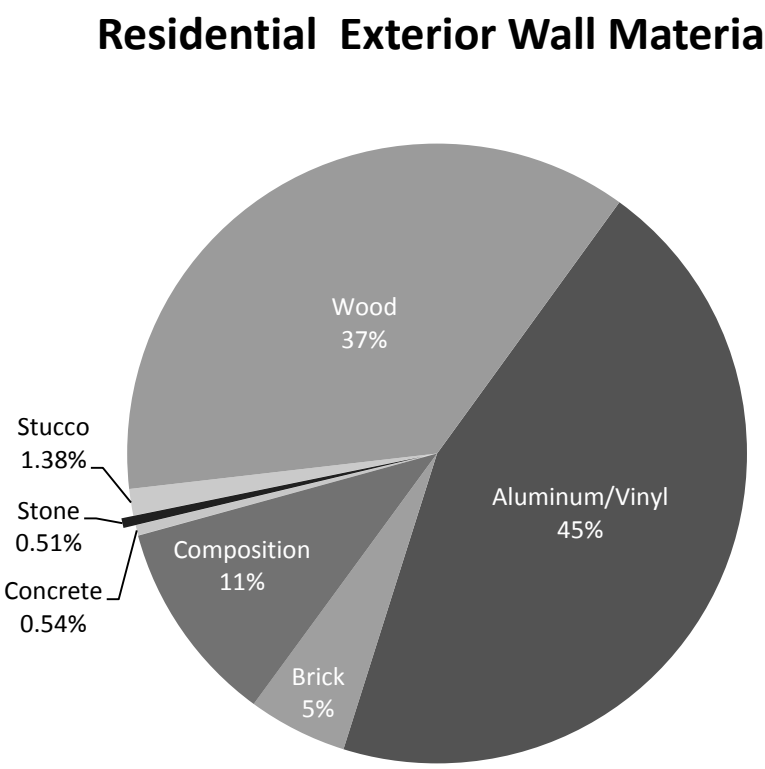

Figure 3. Primary exterior wall material of residential structures in New York State.

Data from another source suggests that the proportion of stone construction in buildings of recognized historic value is even higher relative to other common materials. Figure 4 shows the distribution of building materials in the National Register Information System, a database maintained by the National Park Service that contains sites listed on or found eligible for the National Register of Historic Places.[36]

[35] Prices for materials and labor installed, adjusted for average costs in New York State (+9% national avg.); Dave Ogershok and Richard Pray, eds., *2008 National Construction Estimator*, 56th ed. (Carlsbad, CA: Craftsman Book Co., 2008).

[36] Although these data is heavily biased by the nature of and criteria for nomination of properties to the National Register and is representative only of eligible or listed sites, it does provide a reasonable sample of residential buildings of historic or architectural significance. The percentages for limestone and sandstone are likely higher

Nearly half of the 787 New York sites included in this dataset (most of which are residential) were built using stone as the primary material (including exterior walls and foundation).

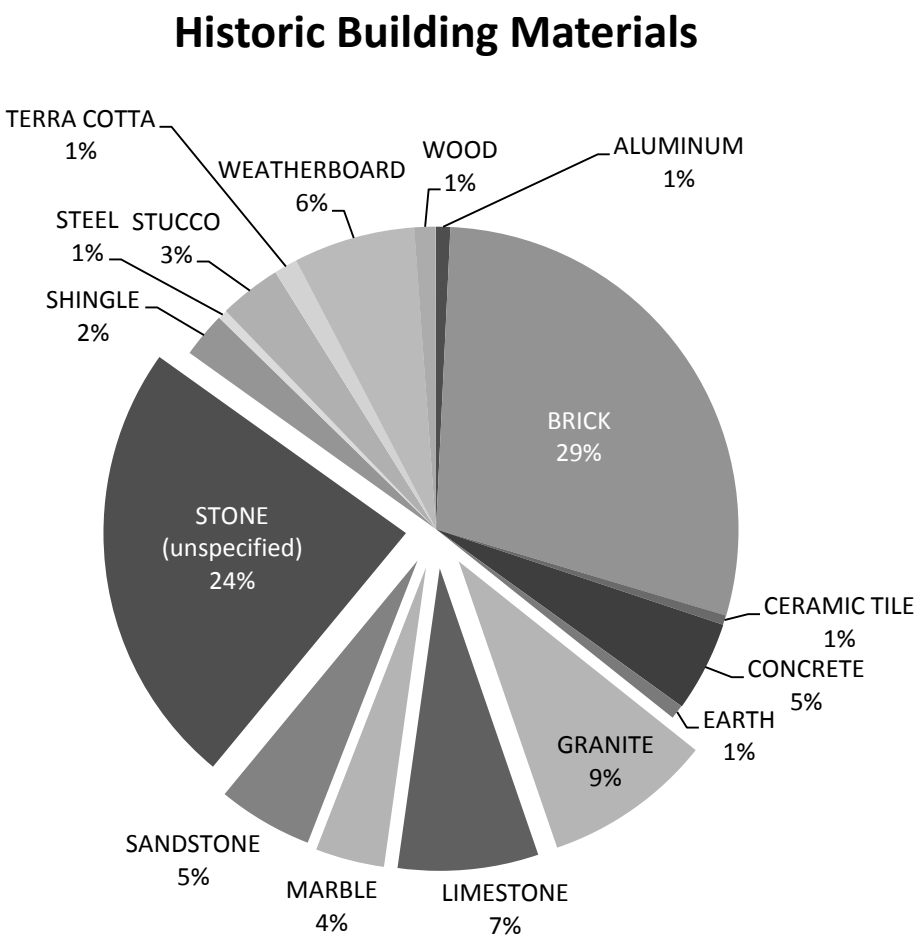

Figure 4. Primary (wall and foundation) building materials for places listed on or determined eligible for the National Register of Historic Places in New York State. Data from US Department of Interior, "National Register Information System," Washington, DC: National Park Service, http://www.nr.nps.gov/NRISDATA (database queried 17 July 2008).

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than the total population of stone buildings in the state than in the relatively small population (787 buildings) represented by this chart. US Department of the Interior, "National Register Information System".

1.3.1 Use

The large majority, approximately 88.7% (12,097 buildings), of stone buildings are used for residential purposes while about 11.3% are used for some commercial, religious, or public function. Figure 5 shows the distribution of uses of stone buildings. The most common non-residential functions of stone buildings are public use (i.e. armories, city halls, court houses, libraries, schools, and other municipal functions; count: 1,542 buildings) and religious use (i.e. churches, convents, rectories, etc.; count: 1,288 buildings). These figures suggest that non-residential stone buildings are most likely to be owned by organization accountable to a group of constituents (e.g. citizens or members of a congregation).[37] The high proportion of residential stone buildings in the data set indicates that stone built resources in New York are primarily owned by either landlords or private homeowners. While, at face value, this data may seem to have little bearing on the state of the stone building stock, whether a building is owned by a public, religious, or private entity can have bearing on the funding available for repair work.

[37] Actual ownership data were withheld by the ORPS to protect privacy.

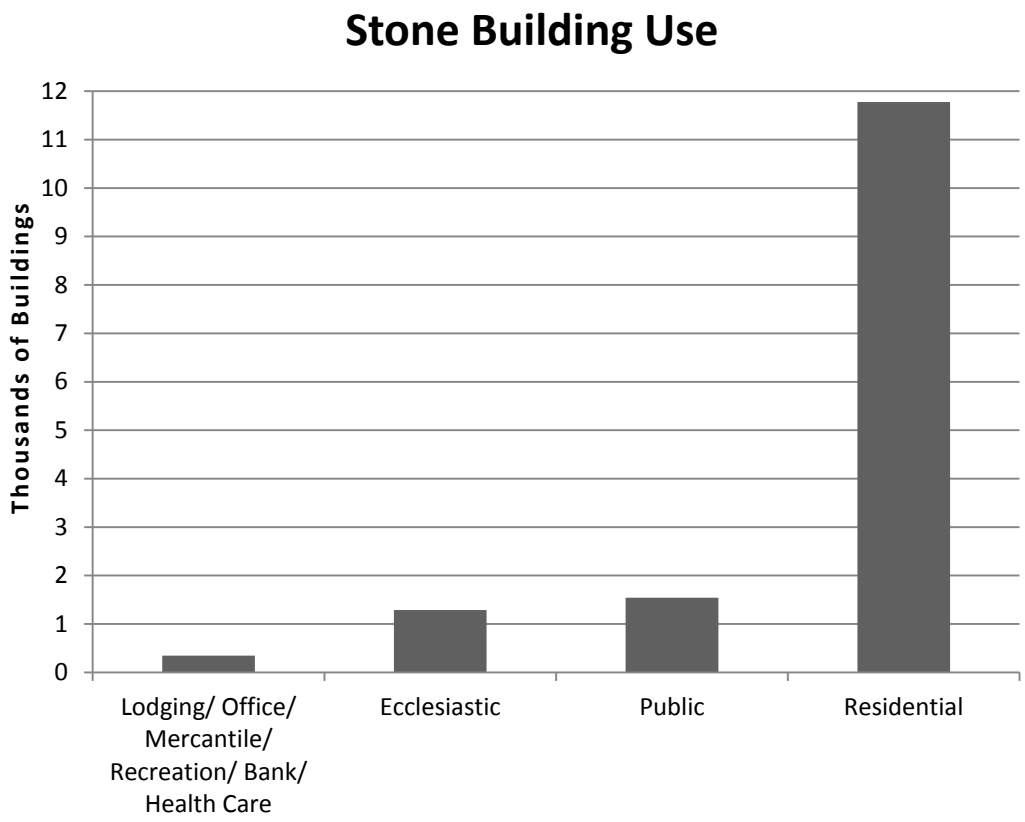

Figure 5. Stone building use in New York State (non-residential uses expanded).

1.3.2 Condition

By and large, the majority of stone buildings (70.95% or 2,357 buildings) in New York State are rated in "normal" condition (i.e. show normal signs of wear and tear for their age with little indication of deferred maintenance or structural damage). Condition data are approximately normally distributed with a slight negative skew (i.e. there are more buildings reportedly in "excellent condition", see Figure 6). However, 8.36% (1,141 buildings) are rated in "poor" to "fair" condition, indicating that maintenance has been deferred and that greater than usual repairs are needed to restore them to "normal" condition.

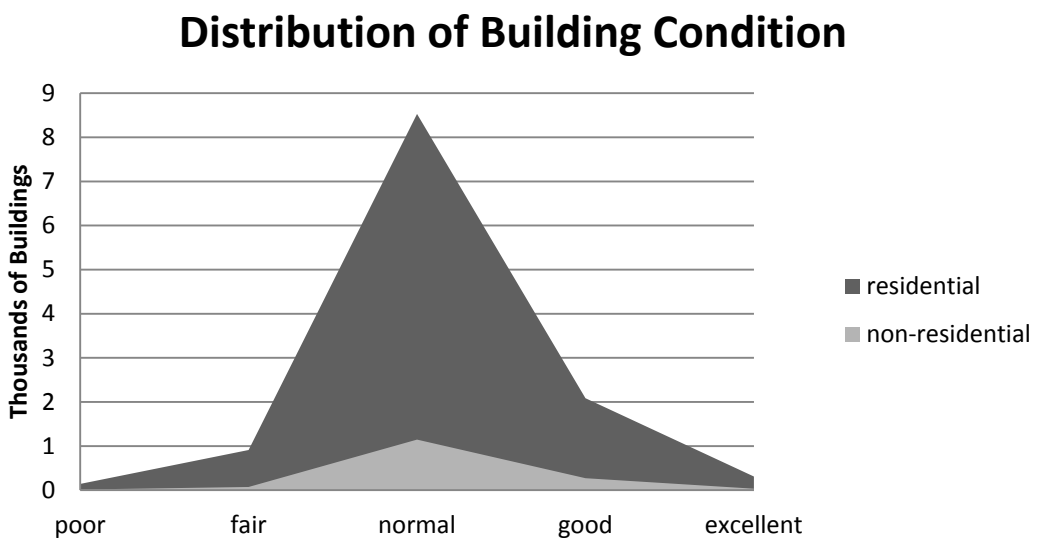

Figure 6. Distribution of building condition ratings in New York State.

1.3.3 Year Built

Data from the RPS indicates that about 50% of stone buildings in New York State were constructed between circa 1900 and 1957, with the majority (635 buildings) built around 1900. The oldest record is for a building constructed circa 1650 and the newest buildings recorded were built in 2007 (15 buildings). Figure 7 (page 31) and Figure 8 (p. 328) chart the number of buildings recorded as being built between 1750 (the earliest date where a significant number of structures appears) and 2007. As noted above, the date of construction recorded in the RPS is dependent upon the reliability of records available to the assessor and is therefore inexact. Visual analysis of Figure 7 exposes the estimative nature of these dates which spike at decade marks in a pattern that is not well explained by typical building trends—i.e. it is unlikely that such high numbers of buildings were actually constructed in the years, 1900, 1910, 1920, etc., relative to the intervening decades. This is not to say that these dates should be discounted as invalid but rather, taken only as approximations. Figure 8 shows the

recorded age of construction of all stone buildings (residential and non-residential) with a ten-year moving average trend line[38] fitted to correct and allow for more accurate visualization of age.

Estimated dates aside, further visual analysis of the RPS year-of-construction records indicates some consistencies with observable characteristics of the built environment and historical building trends. The count of buildings in the charts below is skewed to the left (i.e. the left tail is longer), indicating that newer buildings are more prevalent in the dataset as is observable in the real world (i.e. buildings may be demolished as their age increases and economic utility declines). The greater number of reported stone buildings of more recent construction may also reflect the growth in number of stone veneer options circa 1900.[39] Downward trends in the moving average line plotted in Figure 8 likely correspond to slow periods in the construction industry (i.e. economic depressions, wars, and other events known to affect the building cycle), whereas peaks likely illustrate building booms such as the one that occurred following the Second World War.[40]

[38] A simple ten-year moving average (MA) was calculated for the recorded number of stone buildings, b_{1650}, …, b_{2007}, built each year from 1650 to 2007 using the formula:

$$MA = \frac{b_{1650} + \cdots + b_{2007}}{10}$$

[39] Scheffler and Gerns, "Thin Stone Veneer," 164-173.

[40] Because of the peaks atributed to the assessors' tendency to estimate to the nearest decade, the moving average trend line may give an "artificial" boost to downward trends and, in general, flatten out dramatic events. The moving average also weights more recent dates the same older ones and so, is less accurate towards the right of the timeline where the recorded date is likely to be more precise.

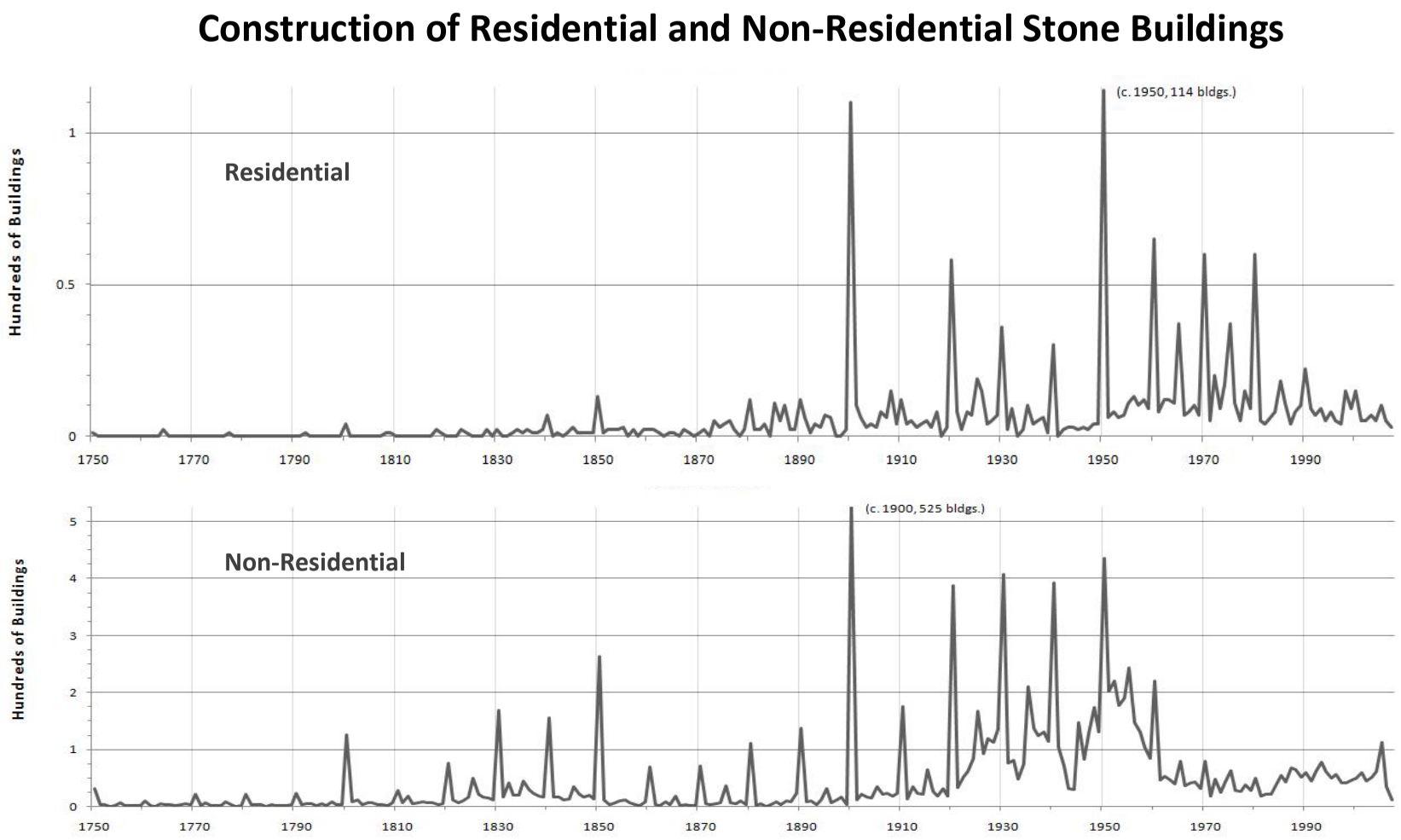

Figure 7. Recorded year of construction of residential and non-residential stone buildings in New York State.

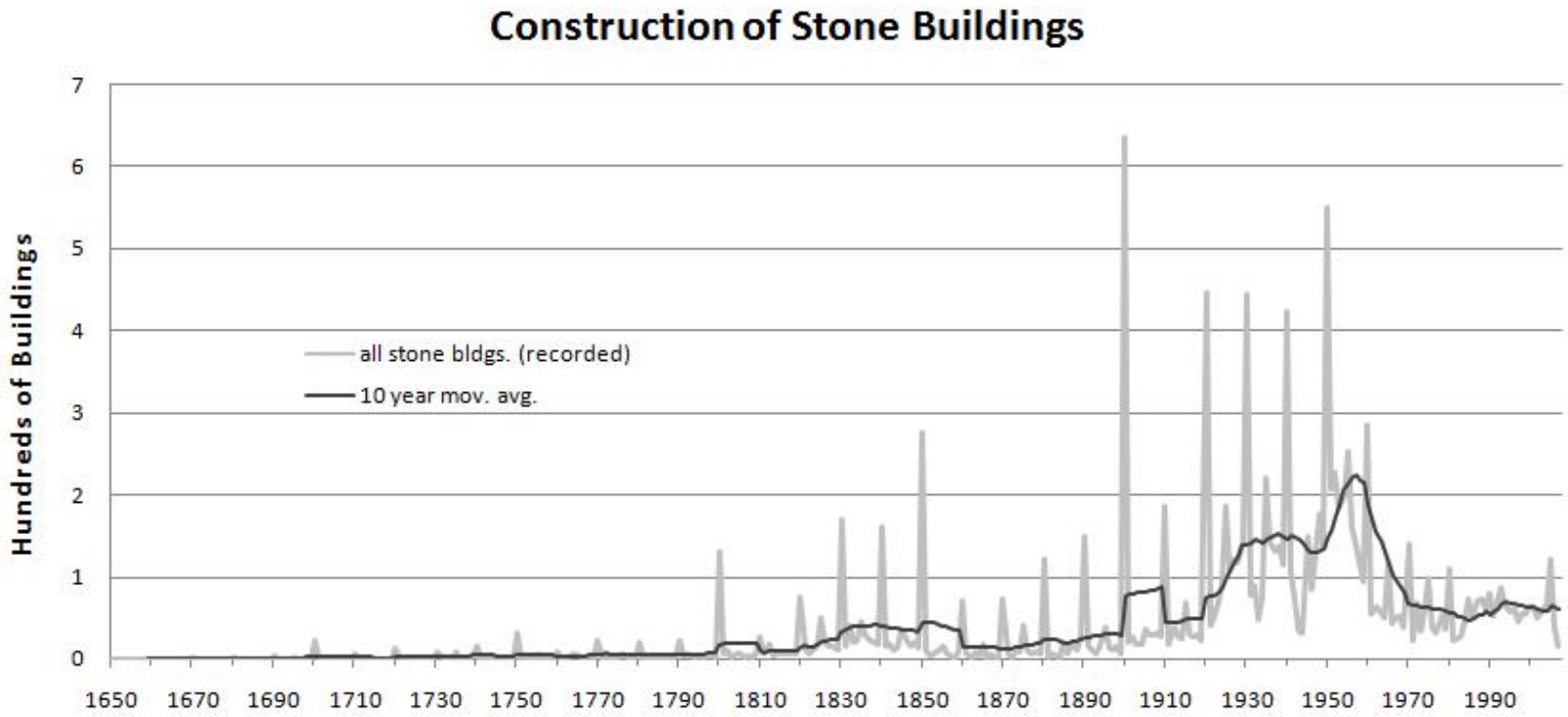

Figure 8. Recorded year of construction of all stone buildings in New York State.

1.3.4 Location

One of the primary benefits of using tax assessment data is that it contains highly detailed geospatial attributes. This enabled records to be tied to the landscape using cross tabulations and GIS to allow for spatial analysis of the stone built environment. Figures Figure 9 through Figure 11 on the succeeding pages show the aggregate distribution of stone buildings in New York State by county or municipality, revealing some interesting patterns. While stone is shown to be a common building material in residential buildings throughout the state, the majority of non-residential buildings of stone construction are distributed along the Interstate 90 corridor which runs from Buffalo in the east to Albany in the west above the Southern Tier Region in the state (see Figure 11). This corridor approximately follows the historical location of the Erie Canal and so, it is possible that a relationship exists between the local building vernacular and the wealth and greater selection of materials brought by canal boats.

Figure 11, showing the distribution of all stone buildings recorded in the RPS dataset, also demonstrates a clear concentration of stone construction in the Hudson Valley Region in the southeastern portion of the state. This is one of the oldest European-settled regions and home to stone vernacular building traditions brought by Dutch colonists in the early seventeenth century. This is also one of the most urbanized areas of the state. In general, darker areas indicating a high number of stone buildings in the maps below are analogous to urbanized areas with high population densities. Along with high concentrations of people and buildings, urban areas have traditionally been centers of wealth, which can be associated with the prestige of stone construction.

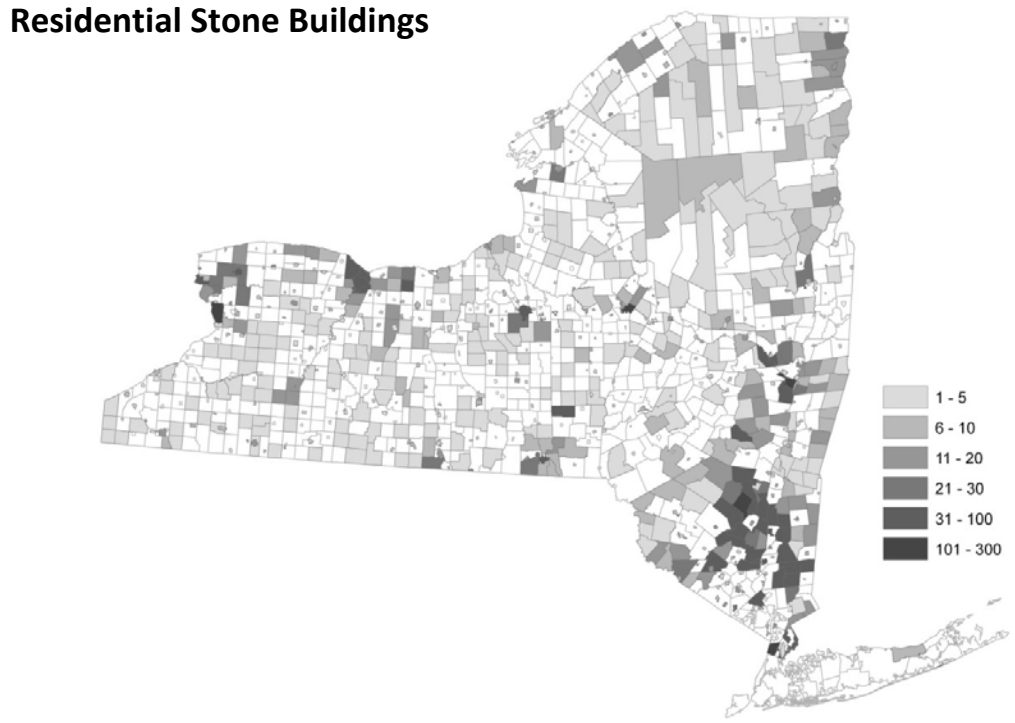

Figure 9. Map of New York State showing distribution of residential stone buildings by county.

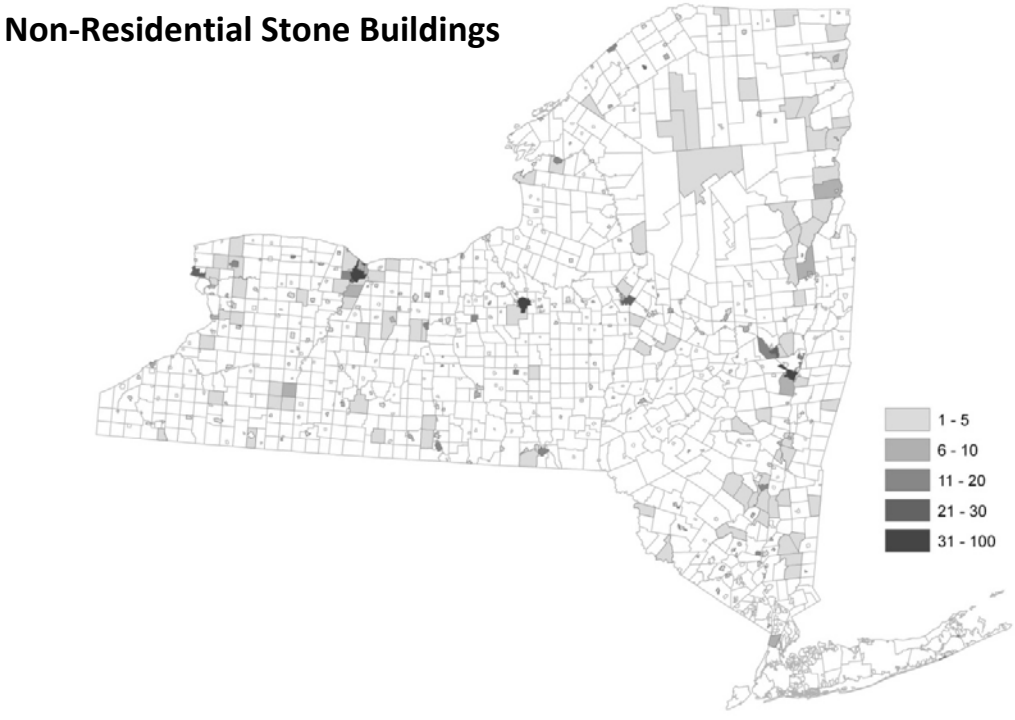

Figure 10. Map of New York State showing distribution of non-residential stone buildings by county.

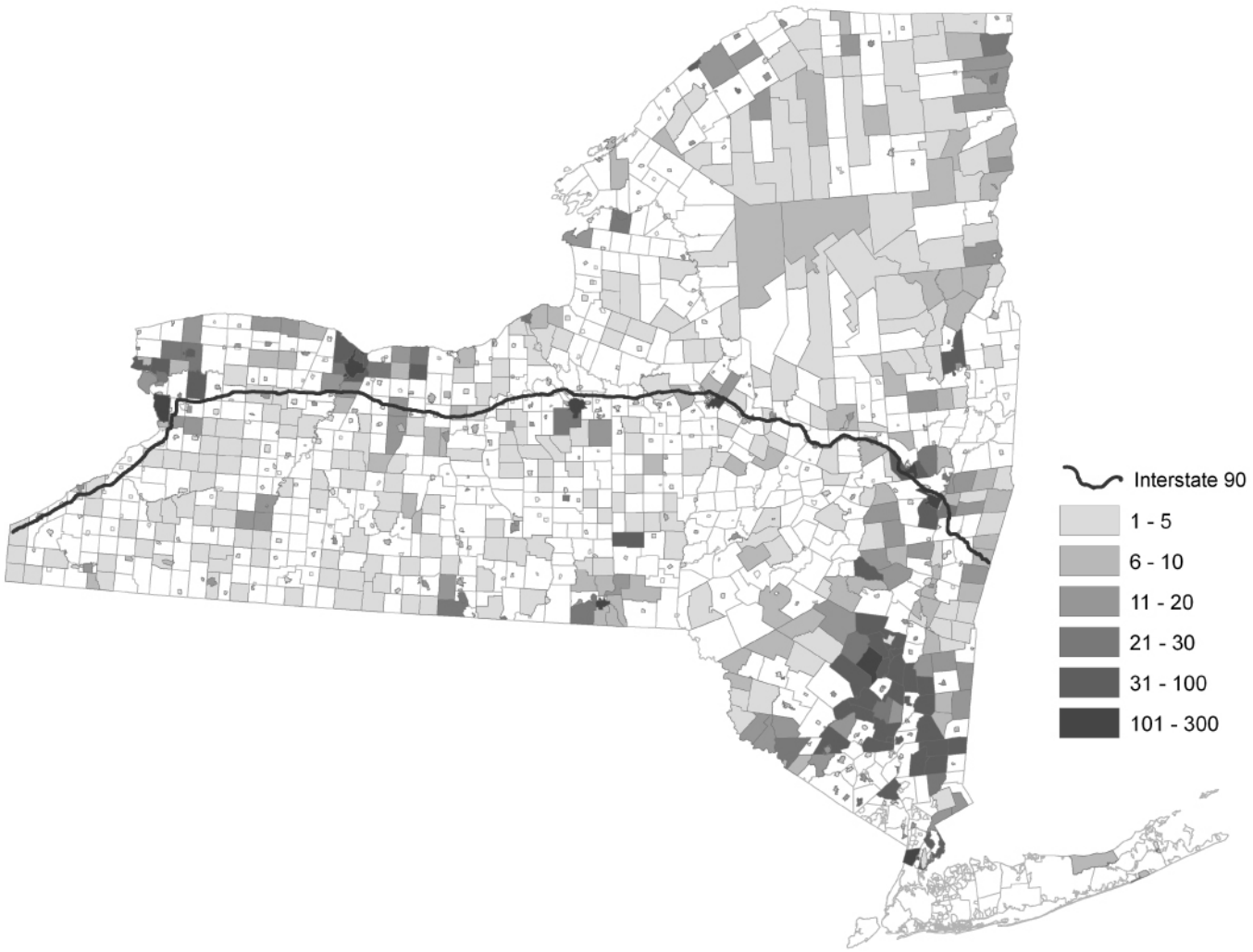

Figure 11. Map of New York State showing distribution of all stone buildings by

All Stone Buildings

1.3.5 Cross-Tabulations: Age, Condition, and Location

To best understand the relationship between building age and condition, these two variables were cross-tabulated.

Figure 12 shows the distribution of building condition recorded in six age groups and reveals three inter-related trends. Even accounting for the disproportionate age interval in the plotted bin for buildings over one-hundred years old, the large majority of stone buildings (4,117 buildings) range between fifty and seventy-five years old. As one might expect, newer buildings are recorded as being in better condition, with fewer under twenty-five years old rated as “excellent”. Although from this chart the condition appears to deteriorate with age, very few (157) buildings received the lowest rating, “poor”. A slightly more significant proportion (7.21% or 984 buildings) are recorded as being in “fair” condition, with a total of 1,141 (8.36%) buildings rated as below “normal” and in need of maintenance and/or repair.

Figure 12. Recorded age cross tabulated with condition.

While it may be reasonable to assume from this data that most building owners are maintaining their property, this trend may be the result of biased data collection.[41] This possibility aside, the overall high condition ratings of stone buildings in the state conforms to the concept that stone is an inherently durable material and suggests that owners take reasonable care to protect their investment.

Nevertheless, at least 8.36% of stone buildings in the state require some form of intervention to improve their condition. Further cross-tabulation of the RPS records reveals geographic areas with the lowest condition ratings and so, highest need for maintenance or repair work.

[41] The incentives for tax assessors to give properties a better condition rating than they deserve may be high. Property tax assessment in New York State is conducted at the local level and a portion of the revenue derived from taxation is allocated for local government use. A low condition rating could have a negative effect on the value of the property and, in turn, reduce its value on the mortgage or real estate markets.

Table 2 lists the distribution of the proportion of buildings by condition in each of the fifty-seven New York counties included in this study (the highest proportion in each column is marked in bold). Westchester, Ulster, and Dutchess Counties (all located in the southern Hudson River Valley) contain the highest number of stone buildings with a relatively small proportion (10 buildings or less) recorded as being in "poor" condition in each. Conversely, Yates, Suffolk (each with less than sixty stone buildings), and Orleans Counties show the highest proportions of building in "poor" condition with no geographic trend apparent.

Table 2. Recorded building condition by New York county.

county	poor	fair	normal	good	excellent	(missing)	total count
Albany	1.09%	5.82%	79.09%	12.00%	2.00%		550
Allegany	1.15%	9.20%	75.86%	13.79%	0.00%		87
Broome	1.86%	14.55%	70.28%	11.15%	2.17%		323
Cattaragus	0.00%	11.27%	73.24%	15.49%	0.00%		71
Cayuga	2.53%	12.66%	69.62%	11.39%	3.80%		79
Chautauqua	0.62%	5.56%	79.01%	14.81%	0.00%		162
Chemung	0.00%	5.74%	83.61%	9.02%	1.64%		122
Chenango	3.96%	11.88%	75.25%	8.91%	0.00%		101
Clinton	2.66%	7.98%	83.51%	5.85%	0.00%		188
Columbia	1.52%	7.58%	56.06%	30.30%	4.55%		132
Cortland	0.00%	11.90%	54.76%	33.33%	0.00%		42
Delaware	0.00%	3.45%	79.31%	15.52%	1.72%		58
Dutchess	0.78%	4.70%	61.86%	30.09%	2.57%		894
Erie	0.00%	2.48%	79.71%	11.24%	6.57%		685
Essex	1.54%	23.85%	40.77%	31.54%	2.31%		130
Franklin	4.88%	10.98%	67.07%	17.07%	0.00%		82
Fulton	0.00%	12.24%	67.35%	18.37%	2.04%		49
Genesee	1.23%	16.05%	65.43%	17.28%	0.00%		81
Greene	3.13%	9.90%	51.56%	16.15%	**19.27%**		192
Hamilton	0.00%	0.00%	**88.89%**	11.11%	0.00%		18
Herkimer	2.04%	6.12%	82.99%	8.84%	0.00%		147
Jefferson	3.82%	16.03%	66.03%	12.98%	1.15%		262
Lewis	4.00%	12.00%	66.00%	18.00%	0.00%		50
Livingston	0.00%	8.06%	69.35%	20.97%	1.61%		62
Madison	2.35%	9.41%	74.12%	11.76%	2.35%		85
Monroe	0.32%	3.65%	81.77%	11.41%	2.85%		631
Montgomery	0.00%	12.79%	68.60%	17.44%	1.16%		86
Nassau	0.00%	6.73%	59.62%	33.65%	0.00%		104
Niagra	1.38%	9.68%	80.65%	7.37%	0.92%		434
Oneida	0.57%	2.65%	82.80%	13.80%	0.19%		529
Onondaga	0.83%	7.18%	77.35%	12.15%	2.49%		362
Ontario	0.58%	11.56%	65.90%	18.50%	3.47%		173
Orange	0.90%	9.24%	55.71%	33.63%	0.51%		779
Orleans	4.19%	16.17%	69.46%	10.18%	0.00%		167
Ostego	0.00%	20.31%	54.69%	25.00%	0.00%		64
Oswego	2.33%	13.95%	72.09%	10.47%	1.16%		86
Putnam	0.52%	6.54%	78.80%	13.35%	0.52%	0.26%	382
Rensselaer	1.55%	6.20%	85.27%	5.43%	1.55%		129
Rockland	1.53%	7.14%	59.69%	25.00%	6.63%		196
Saratoga	5.56%	14.62%	72.81%	6.73%	0.29%		342
Schenectady	0.00%	3.53%	72.35%	19.41%	4.71%		170
Schoharie	0.80%	7.20%	78.40%	13.20%	0.40%		250
Schuyler	2.56%	**25.64%**	66.67%	5.13%	0.00%		39
Seneca	0.00%	10.00%	60.00%	30.00%	0.00%		30
St. Lawrence	0.00%	8.77%	75.44%	15.79%	0.00%		57
Steuben	0.00%	12.50%	70.83%	15.00%	1.67%		120
Suffolk	5.36%	3.57%	42.86%	5.36%	3.57%	39.29%	56
Sullivan	0.46%	9.13%	68.04%	20.55%	1.83%		219
Tioga	0.00%	0.00%	81.48%	16.67%	1.85%		54
Tompkins	1.28%	6.41%	28.21%	**60.26%**	3.85%		78
Ulster	1.13%	8.15%	65.12%	22.65%	2.94%		883
Warren	1.75%	4.39%	62.28%	24.56%	7.02%		114
Washington	0.00%	4.35%	82.61%	13.04%	0.00%		46
Wayne	2.22%	12.00%	65.78%	18.22%	1.78%		225
Westchester	0.29%	2.29%	73.37%	16.01%	3.43%	4.62%	2099
Wyoming	0.00%	10.53%	71.05%	15.79%	2.63%		38
Yates	**11.11%**	13.33%	48.89%	15.56%	11.11%		45
all counties	1.15%	7.21%	70.95%	17.28%	2.52%	0.88%	13639

The incidence of deferred maintenance leading to a high proportion of stone built resources in disrepair may be understood in Orleans and Yates Counties where the economic situation is somewhat depressed yet, this reasoning does little to explain the trend seen in Suffolk County where the *median* household income is over $65,000 per year.[42] Assuming that data were collected uniformly in all counties and that the distribution of wealth among owners of stone buildings is approximately even, this observation would invalidate an argument that puts maintenance in direct relationship to income or other indicators of wealth. Rather, geographic variations in building condition can more likely be attributed to insufficient maintenance activity, possibly due to a shortage of qualified tradespeople in the area (workforce distribution will be discussed further in Chapter 2).

1.4 Estimating Repair and Maintenance Needs

In interpreting data obtained from the ORPS, it is possible to approximate potential future need for repairs to stone buildings in New York State. Such a "forecast" of potential repair needs can be used to understand other needs, namely those for labor and material, necessary to preserve the utility of the stone built environment. The subsections which follow demonstrate how needs forecasting was accomplished beginning by first determining the "effective age" of buildings in the sample (Section 1.4.1) and then projecting potential maintenance needs (Sect. 1.4.2) based upon this determined age.

1.4.1 Effective Age

The "effective age" of buildings was calculated in order to integrate known measures of condition and age into the forecast analysis. *Effective age* is a measure of cumulative depreciation in market value which takes into account improvements made to the building and the degree to which it

[42] U.S. Bureau of the Census, *American Community Survey: Small Area Income and Poverty Estimates*, [Database] queried Orleans, Yates, and Suffolk Counties, New York, 2007, U.S. Bureau of the Census, http://www.census.gov//did/www/saipe/county.html (accessed 2 December 2008).

has been maintained.[43] As such, the effective age of a given building may or may not represent its actual or chronological age since maintenance and design are factors that may increase or decrease the "aging" in this sense. If a building has received better than average maintenance, its effective age may be less than the actual age; if maintenance has been inadequate or deferred, it may be greater. Thus, a fifty year old building that has undergone rehabilitation or modernization may have an effective age of only twenty-five years.

For the purposes of this study, effective age was determined by multiplying the expected "service life" of a building by its "estimated remaining life". *Service life* (sometimes termed *economic service life*) is essentially the number of years from initial construction that a structure is expected to remain functional without the need for major renovation or rehabilitation.[44] This figure is based on the design, materials, and quality of construction of a given building. Given that stone is a highly durable building material, a long service life should be expected for stone buildings and longer still for load-bearing stone construction.[45]

Service life is, however, only a hypothetical figure since it assumes that the structure will receive at least the minimum level of maintenance required to keep it in operable condition and prevent its premature deterioration and depreciation. To calculate the actual "life" it is necessary to account for these variables. This is done by determining the "estimated remaining life" of the structure. *Estimated remaining life* is a function of the extent to which a building has or has not been maintained, considering both interventions necessary to preserve its functional condition and efforts to renovate or modernize the structure to sustain its functional, social, or economic utility.[46]

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[43] ORPS, "Assessor's Manual," sect. 9.7, 12-13.

[44] Ibid.

[45] J. Jackson, ed., *Study of Life Expectancy of Home Components* (Washington, DC: National Association of Home Builders, 2007).

[46] ORPS, "Assessor's Manual," sect. 9.7, 12-13.

The service life of buildings in the sample was determined using methodology specified in the OPRS *Assessor's Manual*.[47] The ORPS system for estimating service life takes into account information regarding the building's structural system, design, and programmatic use and incorporates the assessor's subjective evaluation of the quality of workmanship and materials apparent in the building's construction. This information is then used to specify a construction grade (residential buildings) or quality (non-residential buildings) and corresponding service life. Because the ORPS system of data collection is different for residential and non-residential properties, service life was calculated separately for each dataset. Tables Table 3 and Table 4 give the approximate service life corresponding to the grade or quality of construction.[48]

Table 3. Service life (in years) of residential buildings by construction grade. Adapted from ORPS, "Assessor's Manual," sect. 8.23, 52- 58.

CONSTRUCTION GRADE	DESCRIPTION		SERVICE LIFE
	workmanship and materials	design	
Minimum	inferior	sketches only, usually intended for seasonal use	15
Economy	substandard	sketches only, cost an important consideration	30
Average	average	standard plans, often mass produced	45
Good	good	custom built to specific plans	60
Excellent	excellent	unique, designed by architect	75

[47] Ibid, 12-14.

[48] The ORPS criteria for "grade" and "construction quality" are given in Appendix A.

Table 4. Service life (in years) of non-residential buildings by use and construction grade. Adapted from ORPS, "Assessor's Manual," sect. 9.8, 16-17.

		CONSTRUCTION QUALITY		
BOECKH MODEL GROUP	USE	economy	average	above average
100	Apartment/Lodging	40	45	50
200	Office	45	50	60
300	Mercantile	40	45	50
400	Restaurant/Recreation	40	45	50
500	Professional Services	40	45	50
600	Public	45	60	75
700	Service/Industrial	40	60	75

Estimated remaining life was approximated using the ORPS criteria for rating the condition of buildings (see Section 1.2.3). Table 5 gives the remaining life as a percentage corresponding to the building condition rating. To calculate the effective age (*E*) of buildings in the sample, the following formula was used:

$$E = Y - [S - (S \times R)]$$

Where *Y* is the current year (2007), *S* is the service life, and *R* is the estimated remaining life.

Table 5. Percent estimated remaining life and corresponding condition rating. Adapted from ORPS, "Assessor's Manual," sect. 9.7, 14.

% Remaining Life	Corresponding Condition	Description
0%	Poor	Has received little or no maintenance or repair and requires immediate intervention.
25%	Fair	Has received inadequate or no maintenance and requires renovation or restoration to return to "normal" condition.
50%	normal	Adequately maintained, may require renovation or restoration.
75%	Good	Well maintained, may have been renovated or restored to show little if any sign of deterioration.
100%	excellent	No loss in value due to depreciation from deferred maintenance or repair.

This formula is generally accepted within the real estate community where the motivation is to assess the economic value of a building. However, it has a tendency to yield results which do not give adequate weight to the actual age. For example, a building built in 1700 (307 actual years old in 2007) with a sixty year service life and 75% remaining life would have an effective age of fifteen, the same as a building with similar service and remaining life built in 1992. For the purposes of this study, a simple average of effective and actual age was computed to account for the higher frequency of maintenance and other factors required as age increases. The following example shows the adjusted effective age used:

$$E_{2007} = 2007 - [60 - (60 \times .75)]$$
$$= 1992$$
$$E_{\text{adj.}} = \frac{1}{2}(E_{2007} + E^{*}) = \frac{1}{2}(1992 + 1700)$$
$$= 1846$$

1.4.2 Repair and Replacement Needs

With the adjusted effective age computed for all buildings, expected repair and replacement needs for the next twenty years were projected using durable life expectancy estimates for stone façades.

Life expectancy for any natural building material is difficult to predict. Deterioration of masonry materials is a function of a broad range of factors, including:

- inherent susceptibility of a material to decay (i.e. some stones are simply not as durable as others and predisposed to decay, other may have some flaw that leads to their non-uniform deterioration),
- improper installation (i.e. poor craft knowledge of the material, porous stone installed in a high moisture application such as a foundation or stones installed perpendicular to their natural bedding planes),
- inappropriate or neglected interventions (i.e. introduction of impervious coatings or incompatible repair mortars, abrasive cleaning methods, deferred maintenance),

- human- or naturally- induced adverse environmental conditions (i.e. natural weathering forces such as salt spray in marine environments or freeze-thaw cycles and pollution phenomena such as the deposition of acid rain or other airborne contaminants).

These factors often work in conjunction to promote deterioration. Their combined effect is difficult if not impossible to account for in a controlled way. The complexity of variables leading to decay necessitates life expectancy estimates derived from "real-world" field observations based on a large sample group in a given locale. Unfortunately, few studies of this nature exist. Fortunately, one of the few, conducted by Dr. Alexis A. Julien circa 1880, provides a functional estimate of the durable life expectancy of stone building in New York City. [49]

Julien conducted a survey of the stone buildings in New York City, noting deterioration of the built environment owing to poor craftsmanship, deferred maintenance, and inferior stone. Though admittedly dated, Julien's study is the only source known to this author that provides actual estimates of durability and expected service life given as a function of lithology (i.e. stone type), based on real observed deterioration of buildings in New York State. Julien's findings, shown in Table 6, give an approximation of the expected "life" of the most common building stones that he encountered in New York City, "without regard to discoloration or other objectionable qualities,… [signifying] the period after which the incipient decay of the variety becomes sufficiently offensive to the eye to demand repair or renewal."[50]

[49] Alexis A. Julien, "Report on the Building Stones of the United States," *Tenth Census of the United States* (1880), 10; further details of this study are given in, Julien, "The Decay of the Building Stones of the City of New York and Vicinity - The Buildings, Their Number, and Common Materials," *Manufacturer and Builder* 23, no. 3 (March 1891): 56.

[50] Julien, "Decay of Building Stones," *Manufacturer and Builder.*

Table 6. Durable "Life" of Building Stone in New York City (averages added by author); adapted from Alexis A. Julien, "Report on the Building Stones of the United States," *Tenth Census of the United States* (1880), 10.

Lithology	"Life" in Years	Average
brownstone, coarse	5 to 15	10
brownstone, fine laminated	20 to 50	35
brownstone, fine compact	100 to 200	150
bluestone (blue shale)	100 to 200	150
sandstone, nova scotia	50 to 100	75
limestone, ohio, best silicious	100 to 200	150
limestone, coarse fossiliferous	20 to 40	30
limestone, oolitic	30 to 40	35
marble, coarse dolomite	40 to 50	45
marble, fine dolomite	50 to 100	75
granite	75 to 200	138
gneiss	50 to 200	125

Further insight on the durable life of stone and the age at which stone is likely to require repair may be drawn from the experience of practitioners. In 1998, Young et al. surveyed a sample of architects, developers, and city planning officials in Scotland.[51] Using a series of photographs to illustrate varying types and degrees of deterioration, respondents were asked whether or not they would replace or repair the stone and to identify their reasons as either aesthetic, functional, or structural. Although few respondents thought the decay illustrated was any more than an aesthetic concern, where a structural threat was perceived, replacement was preferred over repair. Respondents were further asked to indicate the timescale which they considered most reasonable for carrying out particular forms of maintenance on stone façades (see Figure 13). Responses ranged from every five years to "never" depending on the type of maintenance. The lowest quartile of all responses indicates that some sort of maintenance may be necessary every five years, with the majority of repairs (averaging all responses) to be expected at the twenty year point.

[51] M.E. Young, J. Ball, R. Laing, "Survey Results Regarding Attitude Towards Stonecleaning of Building Sandstones," in *Durability of Building Materials and Components 8: Service Life and Asset Management,* vol. 1, eds. M. A. Lacasse, D. J. Vanier, 635-647 (Ottawa, NRC Research Press, 1999).

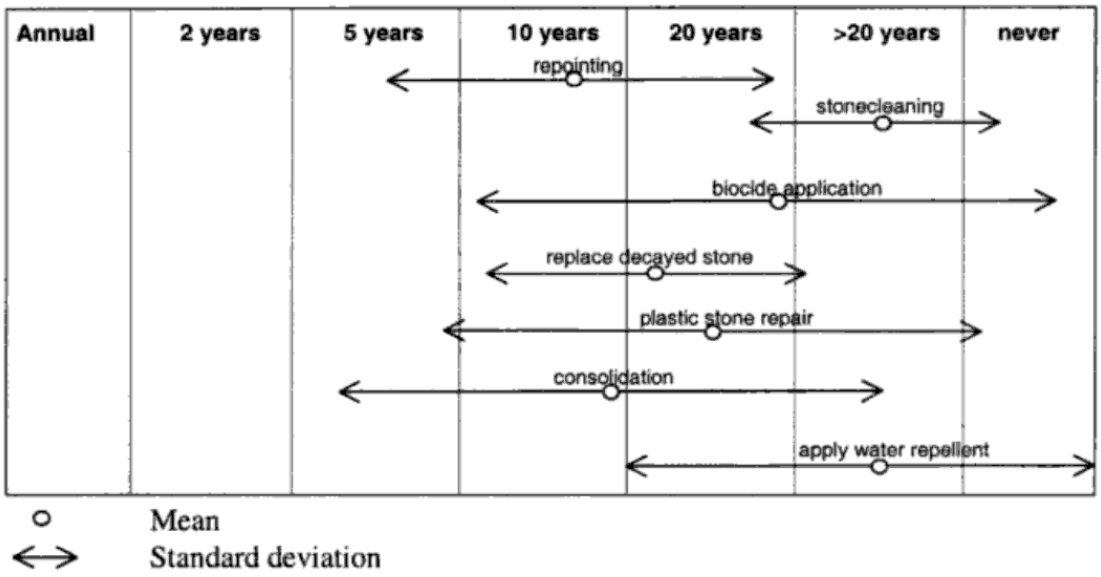

Figure 13. Respondents' answers to the question, "What time scale do you consider reasonable for carrying out the following maintenance on a natural stone building façade?" Reproduced from M.E. Young, J. Ball, R. Laing, "Survey results regarding attitude towards stone cleaning of building sandstones," *in* M.A. Lacasse, D.J. Vanier, eds., *Durability of Building Materials and Components 8: Service Life and Asset Management,* vol. 1 (Ottawa, NRC Research Press, 1999), 641.

From the survey results reported by Young et al., we can also gain some indication of the degree of intervention required over time. The only procedures that all respondents agreed should be performed at some point were "repointing" and "replacing decayed stone with natural stone."[52] For all others interventions, at least some respondents were of the opinion that they should "never" be carried out, with cleaning and the application of biocides or water repellent treatments most often rejected. Perhaps most surprising were the number of responses which indicated that it would be reasonable to expect to perform replacement in twenty years. Julien's "life" estimates (Table 6), indicate that stone exposed in New York City can be expected to last 75 years on average, with the majority of stone types lasting between 35 and 141 years (assumes normal distribution, see Table 7).

[52] Ibid., 639-641.

Table 7. Inter-quartile range of Julien's stone "life" expectancy estimates, based on average (μ) by stone type. From data given in Table 6.

MIN	1st	MED	3rd	MAX
10	35	75	141	150

From the timescale data presented by Young and the durable "life" expectancies given by Julien, we can construct an approximated but reasonable timeline for the maintenance and repair needs of stone façades (see Table 8). Cleaning and the application of biocides and water repellant treatments are omitted. As indicated by the survey responses reported by Young, these interventions are not wholly accepted within the professional or scientific communities. Rather, the activities in Table 8 below focus on repointing, plastic repair, consolidation, and replacement as generally accepted interventions necessary to preserve the structural and functional integrity of stone façades when called for. Table 9 gives the projected number of buildings that, according to this timeline of deterioration, will require some degree of repair or replacement work in the next twenty years.

Table 8. Estimated durable life expectancy of stone building façades.

Age of Façade (years)	Minimum Expected Intervention
10	Cutting and repointing mortar joints
75	Plastic repair, consolidation, or possible replacement necessary
150	Replacement likely

Table 9. Projected number of stone buildings needing repair or material replacement.

Year	Expected Durable Life (number of buildings)			Annual Count
	10 yrs.	75 yrs.	150 yrs.	
2007	58	108	6	172
2008	71	41	11	123
2009	80	34	2	116
2010	102	30	8	140
2011	64	24	0	88
2012	92	51	3	146
2013	84	25	2	111
2014	81	32	4	117
2015	104	29	4	137
2016	83	19	3	105
2017	82	47	4	133
2018	110	38	6	154
2019	82	22	2	106
2020	89	44	2	135
2021	79	19	3	101
2022	114	165	8	287
2023	102	60	3	165
2024	106	34	1	141
2025	108	89	6	203
2026	108	35	1	144
2027	132	133	7	272
Life Count	1931	1079	86	3096

Over the next twenty years, 3,096 (4.4% of the total population) stone buildings will likely require some degree of intervention. According to this projection, eighty-six of these buildings are expected to require some replacement of damaged stone elements. Depending on the size of the area of damage and assuming that only 20% of the façade surface area of each building will require attention, this could mean that over twenty million square feet of stone façade will need repointing, repair, or replacement either now or in the foreseeable future.[53]

[53] Estimate for repair to 20% of the total façade footage (it is unlikely that 100% of all facades will need attention), based on the average square footage of single family homes (the largest proportion of the population of stone

At these projected levels, presumed to represent only a modest estimate, deterioration of the stone built environment could have significant implications for the demand for labor and materials. The projected repair needs for repointing work alone imply a considerable demand for labor. On average, repointing stonework requires from 0.05 (soft mortar) to 0.057 (hard mortar) labor hours per linear foot.[54] Labor hours for other repair and maintenance activities may be even greater. Without data for the surface area requiring repointing or some other form of repair and maintenance work however, it is not possible to infer the total number of labor hours that will be needed to the entire population of stone buildings with any degree of accuracy. Nevertheless, this interpretation of the data suggests that, if even only a portion of the projected needs are fulfilled, sufficient work exists to employ skilled masons well into the future.

Deferred maintenance will exacerbate the repair needs of the stone building stock. Improper, ineffective, and insufficient maintenance of stone structures can grow relatively minor problems into larger ones as deterioration compounds exponentially. Matulionis and Freitag illustrate this principle quite clearly in the book, *Preventive Maintenance of Buildings*.[55] Figure 14 shows a deterioration curve with three forms of mitigating intervention plotted. Deficient maintenance (Line C) allows deterioration to accelerate sharply, leading to increased damage, safety hazards, and repair costs as well as the premature failure and obsolescence of components operating at less-than-optimal condition (terminus of dashed-Line C). Reactive repairs and maintenance activity (Line B) greatly reduce the scale and cost of

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buildings by use) in the Northeast, 1,800 ft^2, at an average story height of 8 to 10 ft (μ 9 ft used for computational purposes) as reported by the National Association of Home Builders; though this number may be large for historic homes, it is thought to be appropriate and even modest since the estimate includes non-residential structures which are undoubtedly larger; Sanchi Gupta, "Characteristics of New Single Family Homes," National Association of Home Builders, http://www.nahb.org/generic.aspx?genericContentID=64030 (accessed 16 February 2009); see also Moya K. Mason, "Housing: Then, Now, and in the Future," Moya K. Mason, http://www.moyak.com/researcher/resume/papers/housing_summary.html (accessed 16 February 2009).

[54] Ogershok and Pray, eds., 2008 National Construction Estimator.

[55] Raymond C. Matulionis and Joan C. Freitag, eds., *Preventive Maintenance of Buildings* (New York: Van Nostrand Reinhold, 1991), 3.

interventions necessary to mitigate or correct minor failures before consequential damage has occurred. The preventive maintenance approach plotted in Line A surpasses the alternatives in terms of effectiveness. Though interventions and associated costs are more frequent, they are significantly smaller in scale. This results not only in greater cost savings over the total life of the structure, less drastic failure events can improve performance and utility and retard the progress of deterioration.

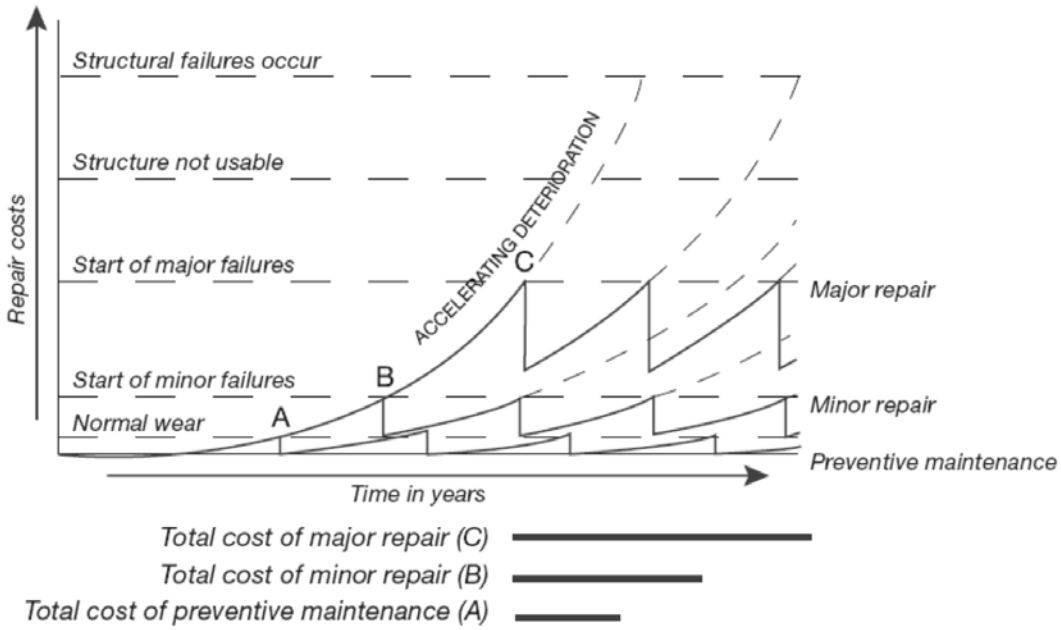

Figure 14. Deterioration Curve and Intervention Costs. Reproduced from Raymond C. Matulionis and Joan C. Freitag, eds., *Preventive Maintenance of Buildings* (New York: Van Nostrand Reinhold, 1991).

Applying Matulionis and Freitag's compounding deterioration concept to the ORPS data we can see that, should the projected repair and maintenance activities not be carried out within the near future, the condition of the stone building stock will deteriorate exponentially. Figure 15 shows the accumulated needs from Table 9 without accounting for curve-shaped growth in deterioration (i.e. a constant and regular rate of deterioration is shown for simplicity). To defer part or all of the projected repair and maintenance work would result in a dramatically different projection than the one shown here. The resulting deterioration would be compounded exponentially, increasing future needs as much

as tenfold. Those buildings currently in the poorest condition may no longer possess any prospect of producing a viable return for the cost of repairs, requiring instead full scale reconstruction or, more likely, resulting in demolition.

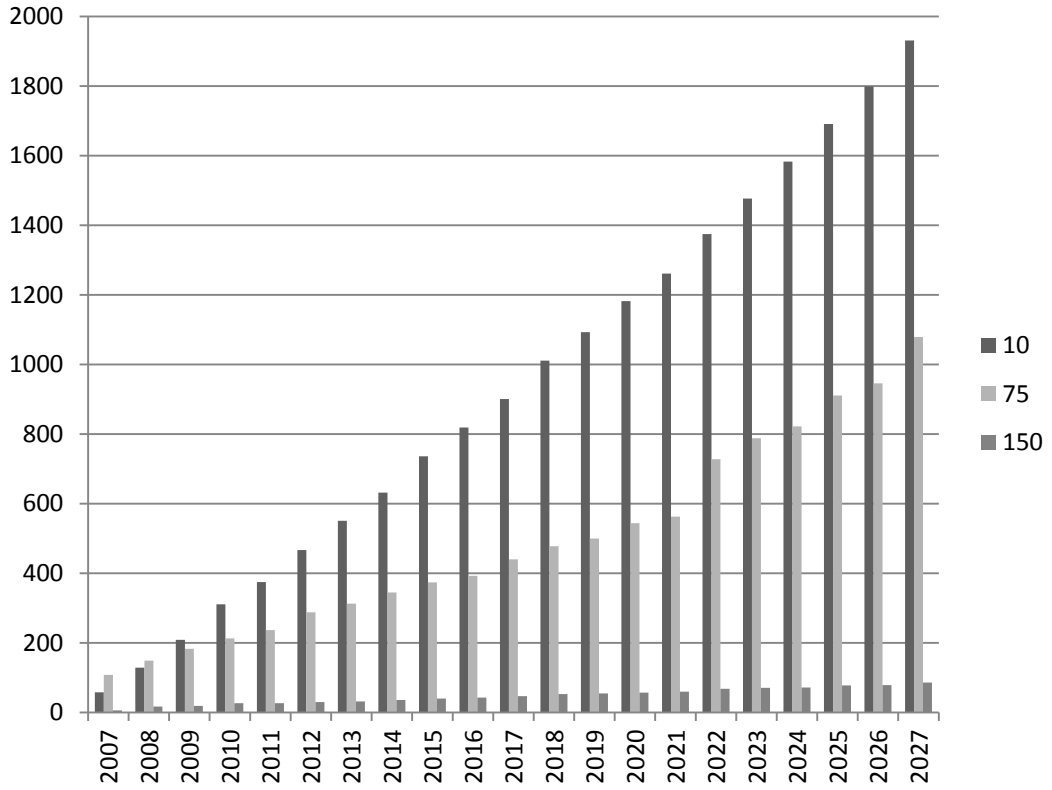

Figure 15. Projected number of stone buildings requiring repair and maintenance accumulated from year 2007 levels.

1.5 Conclusion

Of the four methods for conducting an inventory and assessment of the stone building stock in New York State, analysis of tax assessment records was found to be the most advantageous. Unfortunately, there are limitations to the significance of the ORPS tax assessment data and corollary analysis presented here. While it is reasonable to assume that this dataset provides accurate and reliable spatial and use data and that the age attributes and condition ratings assigned by local assessors are relatively credible, actual field data are needed to cross-check and calibrate the results reported

above. Without field data to corroborate these results, the accuracy and effectiveness of the modeling exercise attempted here remain unknown. Its significance must therefore be regarded as low.

There are additional limitations evident in the RPS exterior building material data which limit the significance of findings here. While we can determine from this data that stone is at least incorporated in the exterior walls of a particular building, it is not possible to determine the exact nature of construction (i.e. traditional load-bearing solid stone walls or thin stone veneer over wood framing). To obtain this degree of specificity, it may be useful to filter the ORPS inventory to include only certain stone buildings using the available age data and historical knowledge of the development of building methods and technologies. Again, the resulting data would have to be corroborated with field sampling. RPS data also do not specify the exact lithologic type of stone or whether a combination of stone types are used.[56]

With limitations to the data and employed methodology apparent, this analysis alone is not enough to form the basis of any decision-making or planning efforts. However, the foregoing exercise demonstrates that tax assessment data possess strong research potential and can be used in studies where the building stock is a research object. The data and analysis above indicate that, at the very least, a need for maintenance and repair of New York's stone built resources exists and will continue to exist in the future. Inferences derived from tax assessment data alone may not provide a satisfactory estimate of the amount of work that is or will be needed. As we will see in the next chapter this information can be obtained by analyzing demand for work and labor on the supply side of the building repair and restoration market.

[56] From the data, one dominant type of stone can be identified in most buildings, however other types may have been employed for different elements of the construction—i.e. stone suitable for walling may not be sufficiently durable for exposed areas, such as quoins or parapets. The flexural strength required for load-bearing elements such as lintels, and the need for large block sizes for certain design requirements may also have necessitated the use of different varieties. Further, some variation may have been chosen for purely aesthetic reasons.

2 MASONRY WORKFORCE LABOR AND SKILLS ASSESSMENT

A shortage of tradespeople skilled in the repair and restoration of historic masonry has often been noted by professionals working in the field of historic preservation. However, little in the way of empirical evidence exists to support or refute these observations. Statistical data are necessary to first identify the nature and scope of any deficiencies and then, to devise some course of action to address any shortages. While statistical data concerned with the construction industry as a whole are readily available, no such information exists specifically for the portion of the workforce occupied with the repair and restoration of masonry constructions (here termed the masonry repair and restoration or "R&R" subsector, a division within the larger masonry sector of the construction industry).

The first objective of this study is to collect sufficient data to accurately assess the current "health" of the stone masonry R&R subsector in New York State and then to identify, quantify, and forecast future need for skilled labor. The term *health* is used here to mean the ability of the subsector to meet demand now and in the future. To accomplish these aims and fill the current information gap, a survey of practicing masons was devised and administered. The survey data were then used to characterize the demographic attributes of the existing workforce, gauge its skill competency, determine the current and perceived future demand for these skills, and identify common training modes. Specific attention was given to the "life-cycle" of the workforce and its ability to regenerate or transfer skills within the labor pool that are lost through worker aging and retirement.

A second objective of this study is to develop and test a prototype from which other studies may be devised. Quantitative projections of construction labor markets provide a useful starting point for determining the approximate magnitude of any future skill shortages. Such projections or "forecasts", however, must be supplemented with information gathered from companies and workers within the industry. Though the labor dynamics of the construction industry as a whole are well documented, this information tends to focus on large firms working on new building projects. Smaller sectors, including

that engaged in the repair and restoration of existing buildings, are either not studied independent of the larger industry or are simply overlooked by industry analysts despite their significant contribution to the economy. Therefore, in order to best understand labor supply and demand issues within the masonry R&R subsector, this study collects and examines information collected directly from companies and workers.

While parallels to labor deficits within other trades and regions may be drawn, this study focuses on the perspectives of masonry tradespeople working in New York State. This state represents a microcosm of the wider US construction market, where the R&R subsector has been growing strongly over past decades and pressures on demand in the face of a deficit supply of skilled labor have led to significant skill shortages in most construction occupations.[57] In New York, the subsector is diverse in its composition of union and non-unionized labor and large and small contracting firms, with work distributed throughout rural and metropolitan markets. Within the R&R market as a whole, stone masonry represents only a fraction of the specialized trade skills practiced. Yet this trade offers a unique perspective into the complexities of the R&R market because of its diverse composition and because the work is conducted both by firms specializing in R&R projects and those whose primary focus is in new building construction.

The sections that follow describe how research into the masonry R&R trade in New York was carried out and discuss conclusions drawn from the data collected. They begin with Section 2.1 describing the methodology employed during the initial and primary phases of the study. Results obtained through primary research are presented in Section 2.2. The most significant of these results are analyzed and discussed in-depth in Section 2.3, with particular attention given to the recruitment,

[57] CPWR—The Center for Construction Research and Training, *The Construction Chart Book: The U.S. Construction Industry and its Workers*, fourth ed. (Silver Spring, MD: CPWR—The Center for Construction Research and Training, 2008), sect. 30.

education, and training needs of the R&R subsector. Finally, the implications of the data collected and the analysis below are summarized in Section 2.4.

2.1 Methodology

Secondary research was initially carried out to establish the context of this study and to provide an understanding of the masonry R&R subsector within New York State. This included identifying datasets and national statistics for employment and reviewing relevant surveys and reports. The "Traditional Building Task Force Timber Frame Survey and Assessment" and *Traditional Building Craft Skills*, a "skills needs analysis of the built heritage sector" in the UK, proved influential in preparing the format of this study.[58] Study of secondary sources alone could not, however, provide significant insight into the current "health" of the subsector. Primary research was necessary to fill information gaps with statistical evidence and understand the views and opinions of those working within the subsector.

During the winter of 2007-08 a survey of masons practicing in New York State, the New York Masonry Labor and Skills Assessment (NYMLSA), was undertaken to collect statistical data related to five major areas of inquiry: demographics, education and training, skills, characteristics of firms, and perceived market demand. While the initial intent was to distribute both a hard copy (via postal mail) and electronic version (created at http://www.masonryskills.org) of the survey to the identified sample group, solicitations for electronic responses were largely unsuccessful (only two were submitted). Each participant received a copy of the two-sided single page survey instrument, a letter of introduction explaining the purpose and voluntary nature of the survey, and a pre-paid return envelope. A copy of the survey instrument is contained in Appendix B.

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[58] World Monuments Fund, "Traditional Building Task Force Timber Frame Survey and Assessment" (unpublished survey results, World Monuments Fund, New York, 2006); National Heritage Training Group, *Traditional Building Craft Skills—Assessing the Need, Meeting the Challenge: Skills Needs Analysis of the Built Heritage Sector in England 2005* (London: National Heritage Training Group, 2005); see also Porter's 1997 survey of the education and training of preservation trades workers, Gary Lynn Porter, "Preservation Technology Programming for Preservation Trades Education," M.H.P. thesis, University of Georgia, 1998, 21-32.

36 Survey questions were formulated to solicit detailed information while limiting the length of the survey so as not to discourage participation. Once the survey instrument had been developed, a beta version was tested on a small group of practitioners with additional comments solicited from experts in the traditional building trades. A final version was submitted to the Cornell University Institutional Review Board to ensure compliance with standards regarding the ethical treatment of human test subjects.

2.1.1 Sample

In order to construct a representative sample of the stone masonry industry within the state, a database was created from a combination of sources, including specialist data suppliers and by searching the Internet for directory listings and business websites, in an effort to identify contractors advertised as working in the trade. Although industry data compiled the Bureau of Labor Statistics (BLS) indicate general employment statistics for stonemasons (classified under SOC 47-2022), no sub-classification exists to differentiate either between the type of work performed (e.g. new building construction or restoration) or the specific trade specialty (e.g. banker mason, stone carver, pointer, etc.).[59] Therefore the approximate proportion of stonemasons specializing in restoration work within the industry as a whole was unknown. Since research suggested that a significant number of firms advertised as "general masonry contractors" actually conduct R&R work in addition to new buildings

[59] The closest relevant classification for all maintenance, repair, and restoration building trades available in the Standard Occupational Classification (SOC) system used by the BLS is for "General Maintenance and Repair Workers" (SOC 49-9042). However this less-skilled classification seems counterintuitive since it would place these trades outside of the Construction and Extraction Occupation major group (SOC 47-0000) and does not jibe with contradictory BLS classification principles which state that, "When workers may be classified in more than one occupation, they should be classified in the occupation that requires the *highest level of skill* [italics added]" and that, "Data collection and reporting agencies should classify workers at the *most detailed level* [italics added] possible." Though precedent for a separate category for maintenance workers within the Construction and Extraction Occupation major group exist (e.g. Highway Maintenance Workers, SOC 47-4051, etc.), no apparent attempt has been made to provide a detailed classification for the R&R building trades which most accurately reflects the high degree of training and skill these craft occupations require. For further information see, U.S. Department of Labor, Bureau of Labor Statistics, "Standard Occupational Classification (SOC) User Guide," Bureau of Labor Statistics, http://www.bls.gov/soc/socguide.htm (accessed 20 November 2008).

construction, a random sample was designed to include an approximately even distribution of both general masonry contractors and contractors specializing in restoration. Attempting to identify and select only those firms specializing in either stone construction or R&R would have resulted in a very small sample group.

According to the BLS, an estimated 660 stonemasons (SOC 47-2022) [60] were employed in New York State in May 2007 (comprising approximately 9% of all brick, block, and stone masons in the state).[61] Using this figure as a starting point, it was determined that in order to achieve statistical significance at the 95% confidence level, a target sample size of 84 would be necessary. However, due to limited financial resources and difficulty locating participants and soliciting responses, this target was not met. In all, the mail survey and email solicitations to participate in the online survey were distributed to 320 masonry contractors.

2.1.2 Delimitations

No specific attempt was made to attain ethnic diversity within the sample. While participants were asked to answer questions regarding their country of origin, no clear feasible method could be devised to solicit participation from "minority" ethnic groups known to work within the trade. This may be due to the informal nature of the non-native workforce. While the reality of undocumented workers within the construction industry became apparent in conducting interviews with architects, tradesmen,

[60] This estimate is likely much smaller than the actual number of working stonemasons since it does not include self-employed workers which comprise a significant proportion of those working in both the industry as a whole and in the R&R sector.

[61] U.S. Department of Labor, Bureau of Labor Statistics, "State Occupational Employment and Wage Estimates: New York," *Occupational Employment Statistics* (May 2007), data available at http://www.bls.gov/ (accessed 12 July 2008).

and other industry experts, few studies to date have managed to collect primary data from this workforce.[62]

Consideration was given to providing both English and Spanish language versions of the survey instrument since research indicated that a large number of Hispanic workers are employed in the construction industry.[63] However, the identified sample group contained few Hispanic surnames and so it was assumed that bilingual provisions would add unnecessary costs and burden.

2.2 Results

The NYMLSA garnered sixty valid responses, a response rate of 18.75%, with the vast majority (98%) replying by mail. Appendix B contains a map of the geographic distribution of respondents and the raw survey responses. The following subsections present the data collected through the NYMLSA, beginning with a description of the demographic characteristics of the workforce surveyed (Section 2.2.1), and continuing with their reported levels and forms of education and training received (2.2.2), the general characteristics of their firms (2.2.3), their skill proficiencies in the masonry trade (2.2.4), and their perceived demand for work (2.2.5).

2.2.1 Workforce Characteristics

To understand the demographic composition of the workforce and whether this affects employment patterns or outcomes such as retirement, participants were asked to provide basic personal details (e.g. age, sex, etc.). The majority (95%) of the survey respondents were males, most (90%) were native born, and most (95%) claimed "Caucasian" ethnicity. The most common demographic

[62] Between September 2006 and February 2007, Golden and Skibniewski conducted a survey of construction workers in Washington, D.C. targeting Hispanic immigrant workers; their pioneering research of this informal workforce suggests—among other things—that that illegal immigrants make up a far greater proportion of the construction workers in low-skilled trades than indicated by national averages; S. K. Golden and M. J. Skibniewski, "Immigration and Construction: The Makeup of the Workforce in the Washington, D.C., Metropolitan Area," *Journal of Construction Engineering and Management* 135, no. 9 (1 September 2009).

[63] CPWR, The Construction Chart Book, sect. 15.

profile representing 42% of respondents was a white, native-born male, aged fifty-one to sixty years old. Women and non-Caucasians represent only 10% of the workforce sample group but are some of the most highly skilled workers (most indicated proficiency at the master craftsman level). While this sample appears skewed toward an older demographic of workers, it is consistent with the construction industry as a whole where the average age has steadily increased over the previous decade.[64]

Workforce tenure and experience were high within the sample. 66% of respondents have worked for over twenty-one years in their trade. Most others have practiced for over ten years and only one respondent reported having worked for less than six years. Tenure and experience do not, however, appear to correlate to earned income. 58% of the masons surveyed earn over $70,000 per year. Both of the two lowest earners in the sample, with an annual income of less than $30,000 per year, reported working in their trade for over twenty-one years.

Income is better explained as a function of firm size (i.e. number of employees per firm) and seasonal employment status.[65] 74% of the respondents are employed full time with most others (24%) seasonally employed. Those reporting seasonal employment earn less on average, with a median income in the $40-50,000 bracket. The reported median income of full-time workers is in the "more than $70,000" bracket. These wages are well above the mean annual wage of stonemasons in New York, $42,810, reported by the BLS for the year 2007.[66] The overall high income among survey respondents is likely explained by their reported high degree of skill. However, it may also be related to the status or role of respondents within their firm.

In addition to demographic characteristics, respondents were asked to specify their role in their firm. Most (85%) are either owners or officers (e.g. president, CEO, etc.) of firms, with 27% being owners

[64] CPWR, The Construction Chart Book, sect. 12.

[65] R^2 (coefficient of determination) = 0.09 at 95% confidence level.

[66] Bureau of Labor Statistics, "State Occupational Employment and Wage Estimates: New York."

of medium sized (i.e. 5-25 employees) companies. High status in firms likely says more about the survey respondents than the sector in general. The mailed surveys were distributed, addressed only to individual firms. So, it is likely that responses were collected predominantly from the person in each firm who receives mail on behalf of the firm and may not accurately reflect the status of "rank and file" workers. Only three respondents described their role as "employee" and none reported being a "trainee/apprentice".

2.2.2 Education and Training

The masons surveyed reported high levels of education with approximately 70% having pursued further education after high school. Figure 16 shows the highest level of formal education completed by respondents. All but one mason reported having earned a degree, diploma, or certificate of some kind and 10% received graduate-level education. These figures do not necessarily correlate to vocational skill development since respondents were not asked to specify the field in which they received post-secondary education. However, judging from the reported age at which they began training in their trade, it seems plausible that much of this education is vocation related. Most began training when they were under the age of twenty-one (71%), with others (26%) beginning when they were between twenty-one and thirty.

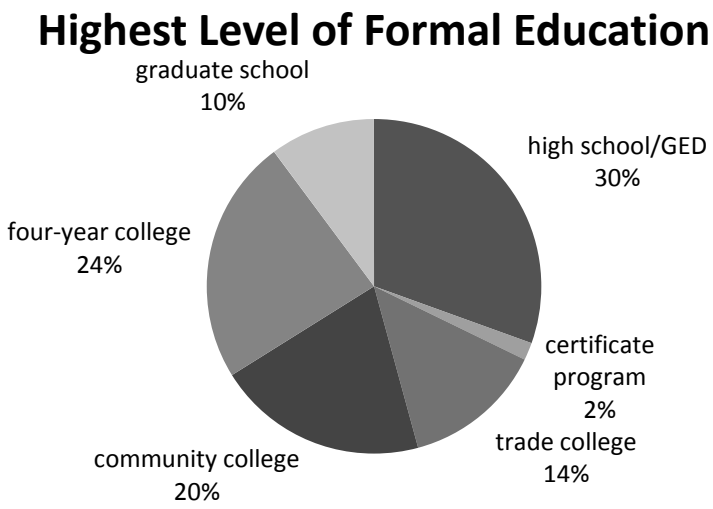

Figure 16. Highest level of formal education completed by respondents.

To ascertain how respondents received training in their trade, they were asked to indicate the amount of time spent training in each of four delivery modes identified during preliminary research:[67]

1. **Vocational education** (including secondary and post-secondary education) leading to a qualification.
2. **Apprenticeship** leading to a certificate or qualification.
3. **Informal on-the-job training** with no formal recognition of competencies.
4. **Short courses** offered by specialist institutions, often leading to a certificate but no qualification; provide continuing education/skill development and not primary trade training.

Figure 17 charts their responses. The majority of respondents reported training on-the-job and/or through apprenticeships.

[67] Adapted from Calpin who identifies three primary modes: vocational, non-vocational, and on-the-job; Kevin Calpin, "Training into the Twenty-first Century?" in *Practical Stone Masonry*, eds. P.R. Hill and J.C.E. David (Wimbledon, UK: Donhead, 1995).

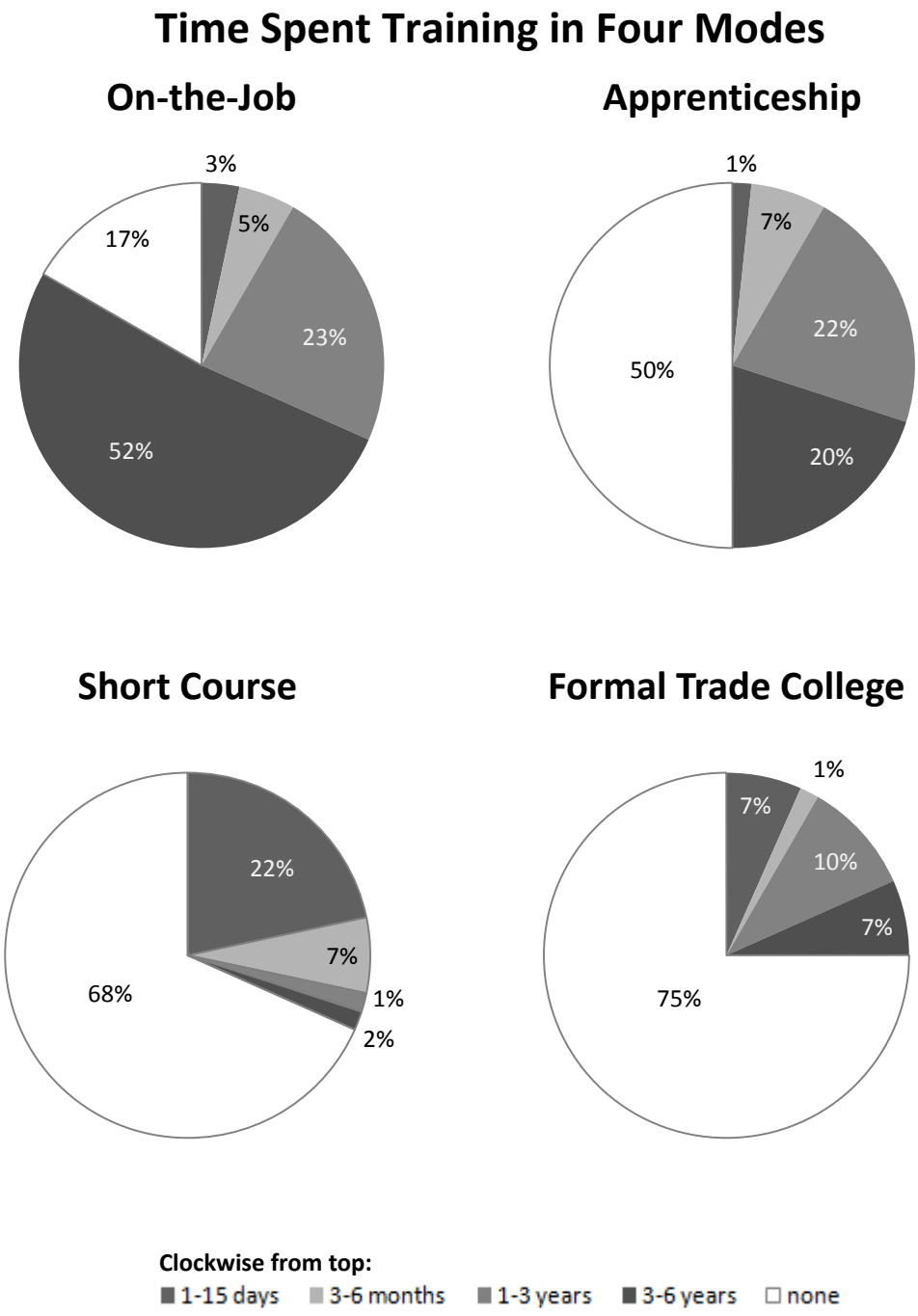

Figure 17. Reported time spent training in the four identified modes.

Of the three formal training modes tested (apprenticeship, short courses, and trade college), respondents spent the most time training through apprenticeship. While this suggests that apprenticeship is a significant contributor to the skill levels of the workforce, less than 49% of respondents reported that their firms currently operate an apprenticeship or other training program. Of

these firms, each employs an average of four apprentices (most firms sponsored only one or two but others, as many as 25). Locating and recruiting apprentices or other trainees is challenging. Over 75% felt there is an inadequate supply of new entrants into their trade. Training new entrants presents another challenge as the existing training infrastructure is reportedly inadequate. Almost all respondents (93%) believe there is a need for more educational or training opportunities for masons.

2.2.3 Characteristics of Firms

The size of firms in the sample is fairly diverse. While only one independent contractor replied, approximately equal proportions of the other respondents worked in firms categorized as small (1 to 5 employees), medium (5 to 25), or large (over 25). 76% of firms in the sample are corporations, 22% are private companies, and only 2% of respondents reported working for a government department.

Firm size loosely explains the type and location of contracts tendered. Large and medium sized firms reported working primarily in urban and suburban areas, while small firms and the sole independent contractor in the sample largely operate in suburban and rural areas. Large firms reportedly work mostly on commercial jobs (34%) but also have industrial (20%) and institutional (24%) projects. While medium sized firms have a large number of commercial projects (38%), they also receive work from residential (22%) and institutional (16%) contracts. Small firms have the highest number of residential projects (41%) and receive tenders for work on commercial (21%) and religious (21%) buildings as well. This data suggests a general tendency of small firms to locate minor markets out of the reach of the larger firms and a willingness to operate in all locations regardless of convenience.

During the preliminary research phase of this study, it became apparent that many firms practice both new construction and R&R. An attempt was made to recreate this distribution in the sample group, only half of which advertised as being specialists in R&R work. This correlates well with survey results. 49% of respondents reported specializing in R&R work. When subsequently asked to specify the proportion of their work considered “historic preservation,” it was found that over 50% of

non-specialist firms engaged in some significant percentage (>25%) of this work. Surprisingly, 11% of firms reportedly specializing in masonry restoration conducted little or no preservation work (<10%). While one might expect R&R-specialist firms to tender considerably more preservation projects than non-specialists, this was not the case. Figure 18 compares the reported percentage of this work conducted by firms specializing in stone restoration and those who indicated that this was not their business' specialty.

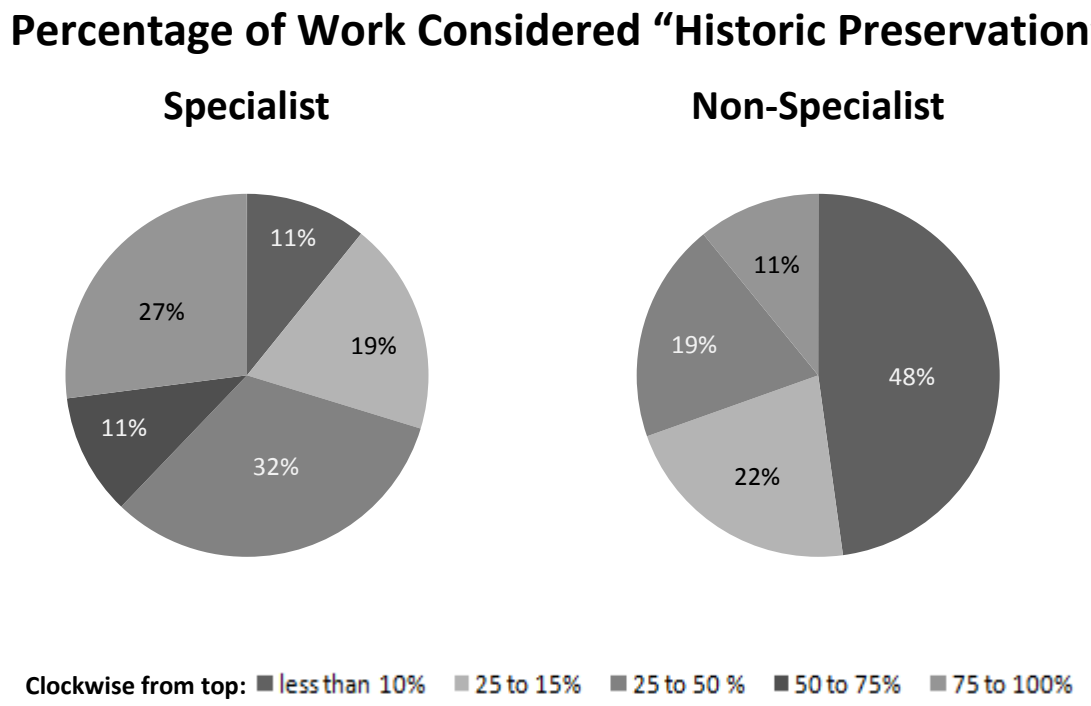

Figure 18. Reported percentage of work considered "historic preservation" in R&R-specialist and non-specialist, new construction firms.

2.2.4 Workforce Skills and Recruitment

In order to determine the level of trade skill proficiency in the existing workforce and to ascertain its degree of familiarity with historic preservation principles and techniques, survey respondents were asked to rank their expertise in skill areas specific to masonry R&R (see Figure 19).

Their responses may be biased by a natural inclination to rate oneself more highly than deserved.[68] The significance of this set of survey data is therefore limited by the respondents' objectivity as well as the limitations of the hard-copy survey instrument.

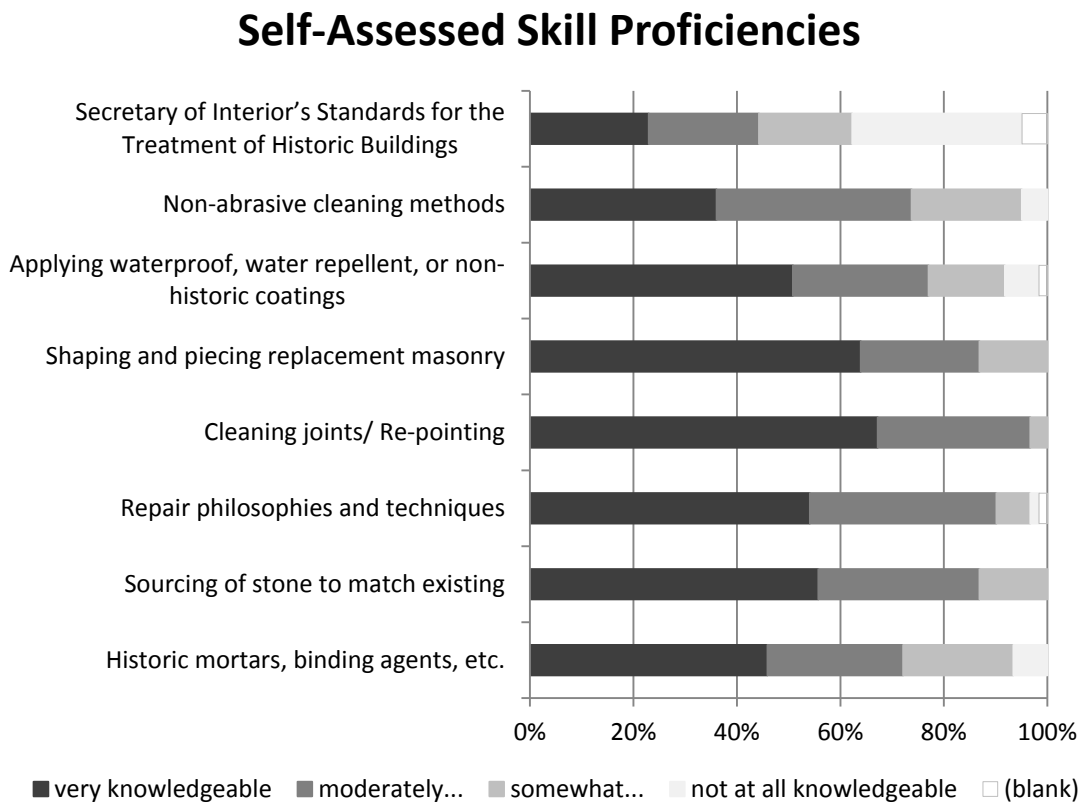

Figure 19. Self-assessed skill proficiencies in selected areas as reported by all respondents.

From the survey responses, few "gaps" in the skills of the sampled workforce are apparent. *Skill gaps* may be defined as the missing knowledge and competence of existing staff.[69] Gaps can lead to reduced output, performance, profitability, quality, safety, and industry image and reputation, as well as increased waste of costly materials. Although narrow gaps exist in knowledge of historic mortars and

[68] Under ideal circumstances, a more accurate assessment of skills would be made by examining the product of each participant's work individually (perhaps through site visits or by interviewing past clients). However, such an undertaking would require more resources than were available for this study.
[69] Sue Richardson, *What is a Skills Shortage?* (Adelaide, Australia: National Centre for Vocational Education Research, 2007).

alternatives to abrasive cleaning methods,[70] respondents knew the least about the *Secretary of Interior's Standards for the Treatment of Historic Buildings*[71]—a basic set of guidelines for historic preservation published by the National Park Service. The absence of specific knowledge of the *Secretary's Standards* is not surprising given that the same questions were asked of all participants and only those specializing in R&R might be expected to have had any exposure to these guidelines. The gap in this area may also indicate a failure to adequately disseminate information regarding best practices in historic preservation to the tradespeople actually performing this work or, conversely, a failure on the tradesperson's part to read and familiarize themselves with the relevant literature.

Prior to this survey, it was assumed that the non-R&R-specialist masons in the sample would be most unaware of the key skill areas assessed here. This assumption, however, proved to be incorrect. To compare knowledge of identified areas, responses were broken out for those respondents whose firms reportedly specialized in R&R work and are charted in Figure 21. Though R&R specialists claimed more knowledge in the identified areas, masons working for new building construction firms were not unknowledgeable (and were, on average, more knowledgeable in certain areas). This distribution is in keeping with the notion that the activities of new construction firms are not limited in scope to new building projects and reveals that respondents working for these firms are at least aware of basic preservation practices.

[70] While a narrow gap also exists in knowledge of applying waterproof, water repellant, or other non-historic coatings, this gap is omitted here because the wording of this particular question may have led to misunderstanding among respondents.

[71] U.S. Department of the Interior, *Secretary of Interior's Standards for the Treatment of Historic Buildings,* Washington, DC: National Park Service*,* Technical Preservation Services, 1992, available online http://www.nps.gov/hps/tps/standguide/ (accessed 1 May 2008).

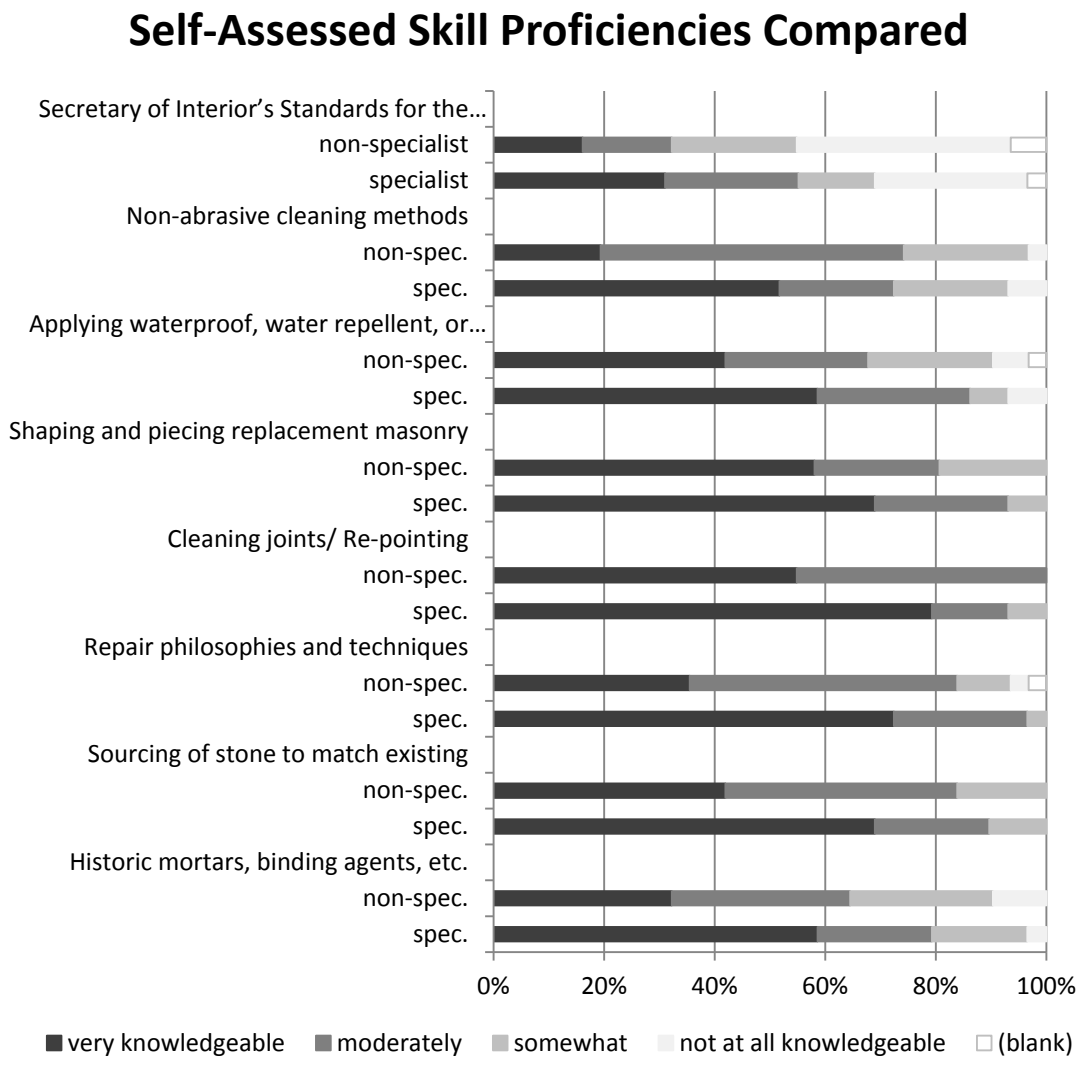

Figure 20. Self-assessed skill proficiencies in selected areas comparing R&R specialist and non-specialist masons.

As a whole, respondents appear to be well acquainted with the R&R skills identified. Most (70%) claimed to possess at least a "moderate" degree of familiarity with these skills and so, knowledge of R&R within the sample can be considered high. This conclusion is consistent with the reported skill level of participants of whom nearly all (95%) considered themselves masters of their trade.

While results indicate a high degree of skill among survey respondents, this may not be true of the workforce in general. Many respondents (69%) reported a shortage of skilled workers in their trade. A *skills shortage* is defined as the inability to recruit people with suitable skills at an appropriate wage as

is often indicated by long-term unfilled vacancies and understaffing.[72] Shortages can stifle productivity and growth, resulting in long working-days and high overtime rates. As with skill gaps, shortages affect a firm's performance and profit, including their capacity to bid for, undertake, and complete new projects. Difficulty in finding new entrants to the trades as well as quality labor from within the existing workforce and can increase both employers' wage and recruitment costs. The adverse effects of shortages are inevitably passed on to customers through inflated bids, cost overruns, and delays in commencing construction and project completion.

In the open comment section of the survey, respondents repeatedly described difficulty enlisting capably-skilled workers. An observation from one mason is typical of the comments received: "In the last 16 years I've seen our labor pool decrease and become weaker [in terms of] talented workers." Even when supposedly qualified workers could be found, some expressed dissatisfaction with the quality of their new hires, as one notes: "I have found that through the local unions, labor is at best mediocre." These responses imply that there are a number of unfilled (or unfillable) vacancies in skilled positions and indicate inadequacies in the skills of the available labor pool.

Preliminary research suggested that workers skilled in certain specialty areas of the masonry trade can be more difficult to find than others. It also suggested that masons may specialize in more than one aspect of the trade. So, in addition to knowledge of R&R-specific skills, respondents were asked to indicate their primary and secondary trade specialties. Eight common areas of specialization were identified within the trade and are defined for the reader below.

- **Brick or block-layers:** Lay and bind masonry building materials including brick, structural tile, concrete block, glass block, terra-cotta block, cut natural stone, artificial stone, and stone veneer with mortar and other substances to construct or repair walls and other structures.
- **Banker masons:** Specialize in shaping structural (or semi-structural) stone elements into the geometrical shapes required by a building's design, working from a workshop either on or off-

[72] Ibid.

site. They produce anything from simple chamfers to tracery windows, detailed moldings, voussoirs, and other classical architectural elements from roughly dimensioned stone blocks using air chisels and hand tools.

- **Fixer masons:** Specialize in the setting of stones onto buildings using traditional lime mortars, modern cements, and metal dowels or cramps to construct or repair walls and other structures.

- **Stone carvers:** Shape stone into abstract designs and architectural ornaments using air chisels and hand tools. They differ from banker masons in that the product of their work generally fills an aesthetic, rather than functional role.

- **Dry stone masons:** Lays stone rubble or dressed ashlar blocks without the use of mortar, cements, or any other binding agent to construct or repair walls, fences, bridges and other structures.

- **Monument masons**: Carve and repair stone monuments, memorials, tombstones, and inscriptions using air chisels and hand tools, and set them using traditional lime mortars, modern cements, epoxies, metal flashings, and mechanical fasteners. Their work includes professional activities similar to those of fixer masons and stone carvers but differs in that the structures they produce or repair are generally not inhabited.

- **Masonry materials conservators:** Undertake technical examination, preservation, and conservation of masonry materials to determine their original structure and materials; the extent of deterioration, alteration, and loss; and take action to retard or prevent further deterioration or damage by control of their environment and/or treatment of their structure. They may conduct minor repairs to or replacement of deteriorated or damaged materials when necessary but are, however, distinct from the masonry trades in that—by the nature of their activities—they do not create new structures.

- **Quarriers/suppliers:** Quarriers include quarrymen and sawyers. Quarrymen split rock and extract the resulting blocks of stone from natural deposits. Sawyers cut these rough blocks into dimensioned cubes of the required size (usually with diamond-tipped saws). *Supplier* is a more general term incorporating all those involved in the extraction or manufacture of masonry materials and whose activities include bringing these materials to market.

All of the eight key areas of specialization specified were represented in the sample group (see Figure 21). The majority of respondents (65%) claimed "brick or block –layer" to be their primary trade. The high proportion representing this trade specialty within the sample group might be expected as this is the most common specialty in new building construction.[73] A greater number claimed a secondary

[73] The BLS reports that 6,670 brick and block masons were employed in the state in 2007, compared to 660 stonemasons. Bureau of Labor Statistics, "State Occupational Employment and Wage Estimates: New York."

specialization in another area, and only 28% claimed no secondary specialty. The least represented specialty areas within the sample were dry stone and banker masons. Although not masonry trades in the purest sense (i.e. they do not actually build anything), the closely related professions of masonry materials conservator and quarrier/supplier were also represented in the sample.

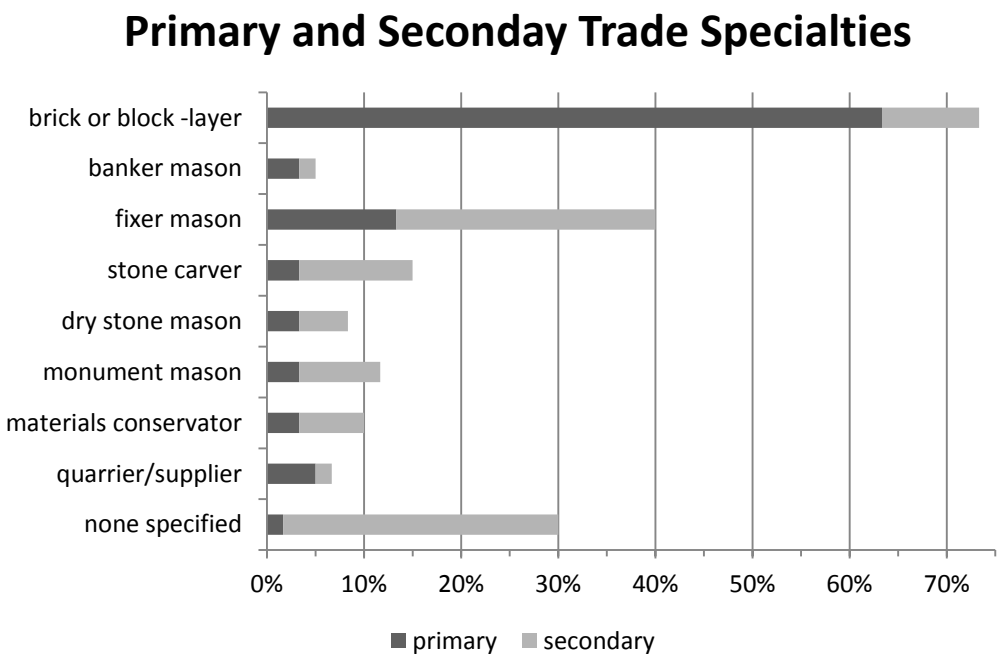

Figure 21. Percent of reported primary and secondary trade specialties (professional areas omitted).

2.2.5 Demand for Work and Supply of Materials

In Chapter 1, analysis of tax assessment data from the New York Office of Real Property Services demonstrated that while the stone building stock is largely in good condition, the need for masonry R&R services in the state should theoretically continue to increase over coming years. However, this data can only illustrate the scope and nature of potential need and does not indicate actual market demand. To assess demand for R&R skills, survey respondents were asked a series of qualitative questions regarding the current and perceived future workload of their firms. Their responses largely pointed toward stable or increased demand over coming years.

Most firms with greater than 10% of their business considered historic preservation reported working on twenty to thirty projects a year. Medium (5 to 35 employees) and large (over 25 employees) firms worked on fewer projects (10 to 30 per year), presumably greater in scale, while small (1 to 5 employees) firms generally worked on less than twenty projects per year. When asked how they expected the number of projects they work on to change in the next five years, 66% of respondents felt that demand would stay about the same, 25% projected an increase, and 9% expected the number to decline. Respondents' perception of stagnant to moderate growth may be attributable to a recession in the US economy which began in December 2007 as the survey was being distributed.[74]

The distance travelled by firms to tender work can be another indicator of demand. While the majority of respondents (67%) reported that their work was conducted in New York State within 100 miles of their firm's base location, a significant number (28%) reported their area of operation as the Northeastern United Sates, travelling from 100 to 300 miles to work. Other respondents reported a national area of operation and, 7% travelled as much or more than 12,000 miles for work. This information suggests that, although work exists to employ masons within the state, the industry operates on a regional—and to a lesser degree, national—basis with workers travelling great distances for projects.

Responses suggest that the distance travelled for projects is related to specialization in restoration work. 45% of those firms specializing in restoration travelled greater than 100 miles for work while only 26% of firms reporting no specialization in this area travel those distances. It is clear from the survey responses that demand extends beyond state boundaries (i.e. the market is geographically large)

[74] National Bureau of Economic Research, "Determination of the December 2007 Peak in Economic Activity," National Bureau of Economic Research, Business Cycle Dating Committee, http://www.nber.org/cycles/dec2008.html (accessed 11 November 2009).

and that, for those firms specializing in stone restoration, demand is sufficiently high in other locations to draw workers in from great distances.

The subsector's ability to meet demand is tied to the supply of materials. In particular, restoration work often requires the procurement of stone and mortar compatible with existing materials. The supply of stone in particular may be hampered by two major factors: 1) some of the quarries that historically produced building stone are no longer in operation; 2) of the quarries that continue to operate, many are engaged in the more lucrative production of crushed stone and aggregate or only extract stone in thin slabs for use as veneer (not the large blocks historically used in load-bearing stone construction). Thus, replacement stone for older structures must be sourced on case-by-case basis through small-quantity procurement contracts.

Informal interviews with architects and builders conducted in preparation for the survey suggested that difficulty obtaining appropriate stone is a common cause for concern. However, less than 9% of the survey respondents agreed. The greatest difficulty in obtaining these materials was reported by those whose firms do not specialize in stone restoration, suggesting that the supply of appropriate materials is not a major issue among those masons regularly engaged in R&R activities or that they are more adept than non-specialist firms in locating these materials. Still, demand for structural building stone is a niche market and large stone blocks are seldom used in modern architectural applications (save for monumental purposes). So while supply of these materials may be sufficient at present, it is conceivable that masons could encounter greater difficulty procuring stone of a certain type and in the small quantities needed for R&R work in the future.[75]

[75] In the years since this research was conducted, the last remaining quarrier of brownstone, a prominent New York building stone, ceased operations. Elizabeth A. Harris, "Bidding Farewell To a City's Precious Stone," *New York Times*, October 23, 2012, A18.

2.3 Discussion

The following subsections contain a discussion of the data obtained through the NYMLSA, drawing correlations to secondary research. Rather than delve into a discussion of all of the data presented above, much of which is self-explanatory or has already been explained, this section focuses on key themes that are critical to the health of the masonry R&R subsections including, workforce aging and skill continuation (Section 2.3.1), training (2.3.2), and recruitment (2.3.3). In addition, the issue of qualifications standards for the trade is discussed in Section 2.3.4.

2.3.1 Workforce Aging and Skill Continuation

Preliminary research suggested that workforce aging could negatively affect the transference of skills from the current generation of workers to the next, within the masonry trade. In 2005, around 4.4 million baby boomers (between 42 and 60 years of age) were employed in the construction industry, accounting for approximately 40% of the construction workforce.[76] As the baby-boomer generation moves out of active employment, the industry as a whole will face a labor shortage and, in particular, shortages of highly skilled and experienced trade workers. Evidence of this trend in other specialty subsectors of the industry suggests an even higher rate of ageing and retirement among these workers. A nationwide survey of timber framers conducted by the World Monuments Fund in 2005 reported a shortage of skilled workers, deficiencies in recruitment and training, and a high percentage of workers (44.8%) over the age of fifty.[77] In light of this evidence, one of the hypotheses formed at the beginning of this study was that the masonry R&R subsector could be in danger of losing trade skills at a significant rate due to workforce ageing and retiring. Unfortunately, due to the potential bias in worker age data collected through the NYMLSA (see Section 2.2.1), it is not possible to definitively determine whether workforce aging and skill continuation are truly issues that would impact the subsector.

[76] CPWR, The Construction Chart Book, sect. 12.

[77] World Monuments Fund, "Traditional Building Task Force."

If the age data collected from the survey respondents is at all representative of the subsector, it would not only confirm a workforce aging trend but also suggest that shortages in the masonry R&R labor pool will be even higher than in the industry overall. The majority (44%) of NYMLSA respondents are between fifty-one and sixty years old (see **Error! Reference source not found.**). The size of the sample group drops significantly over the age of sixty, suggesting that a large number of masons retire once they reach this age. Further, the age of the workforce is heavily biased toward older workers, with 90% of respondents over the age of thirty and most within the baby-boomer age group. The apparent maturity of this sample indicates that a severe shortage of skilled workers due to retirement is imminent in the next ten years. If baby-boomers retire as expected, the workforce (already inadequate in size) will lose as much as 51% of its most skilled workers. This means that approximately 170 new workers will need to be hired and trained to fill positions vacated by retirees in the next ten years (from 2008). Unfortunately, due to the aforementioned potential bias in data collection, these data may not be reliable.

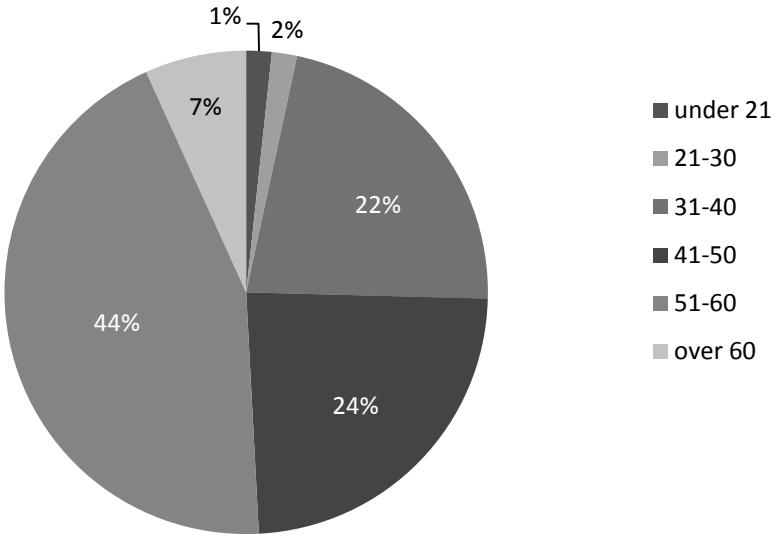

Figure 22. Reported age of R&R stonemasons.

With boomers retiring, the bulk of the workload will fall to so-called the "baby-busters" (born 1965-76) who are already active in the labor market. Yet, due to their much lower birth rate and number in the workforce, as apparent in the sample here, this group may not be able to fully fill vacancies left by retired baby boomers. In the construction industry as a whole a labor shortage brought on by the aging workforce has been partially mitigated by a large number of new immigrants, namely Hispanic immigrant workers, entering the workforce. However, many of these new workers have a lower education level and are employed in less-skilled work.[78] If new immigrants are entering the R&R specialty trades, their presence is not apparent in the NYMLSA sample. Only 3% of the workforce surveyed is under the age of thirty and all were born in the United States.

Workforce aging has a direct impact on skill levels within the subsector. To better understand this impact, it is useful to consider the "cycle" of worker skill development (see **Error! Reference source not found.**). In these terms, skills are initially invested in the workforce when new entrants start training in their trade. Survey respondents overwhelmingly reported beginning training when they were under the age of twenty-one (71%), with most others (26%) beginning when they were between ages twenty-one and thirty. Traditionally, it still takes a considerable amount of time and effort to reach a level of competency sufficient to enable workers to practice their trade without supervision. On average, NYMLSA respondents spent seven years in training, so it is reasonable to expect that new entrants to the trade will take this long to reach the requisite level of proficiency to work independently.

[78] CPWR, The Construction Chart Book, sect. 12.

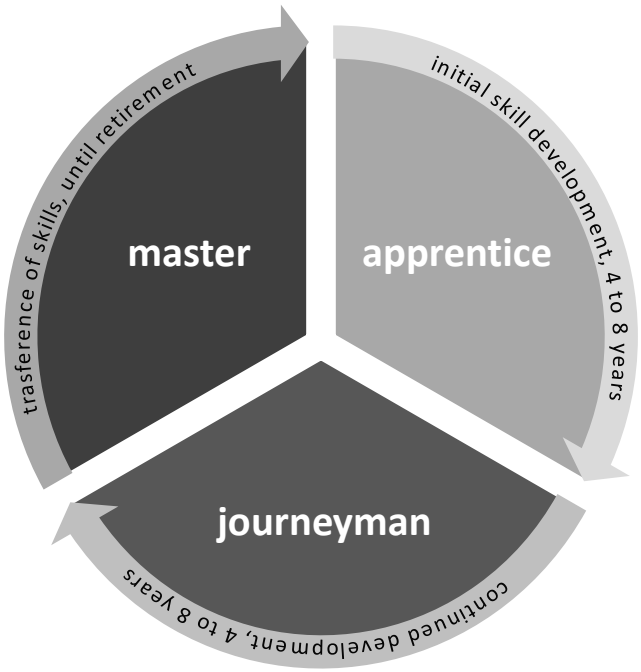

Figure 23. Trade skills cycle.

The trade skills cycle continues once an apprentice has advanced to become a journeyman. After the initial investment of skills, reinvestment occurs through continuing education, task training, and cross-training (i.e. when a tradesperson trains in a specialty outside of his or her initial trade). Sixty-nine percent of respondents reported attending a cumulative one to fifteen days worth of short courses and workshops during their career. A further 29% spent a total of three to six months in such environments. Opportunities for continuing education allow trade workers to both refine existing skills and learn new ones as well as share knowledge with other course participants.

Skills which have accumulated over a lifetime of practice and training are, in effect, recycled within the labor pool if and when the master tradesman passes their trade knowledge onto an apprentice. Yet as noted before, less than half of NYMLSA respondents reported that their firms operate an apprenticeship program and of these firms, an average of only four apprentices are employed. Furthermore, other training opportunities are limited in content and availability. With a substantial

percentage of the workforce due to retire in the next ten years, recruitment of new entrants must increase and apprenticeships and other forms of training must dramatically expand in capacity in order to meet future needs and sustain masonry R&R trade skills.

2.3.2 Training

Respondents to the NYMLSA overwhelmingly indicated that there are insufficient training opportunities available for their trade. Further, many felt that there is a shortage of skilled workers in their trade suggesting a need for more or improved training. Primary research indicates that masonry training is available in New York State in each of the three formal training modes identified above. However, training programs providing specialization in stone masonry and masonry restoration are few. Limited availability of training opportunities in specific modes may explain low participation in these types of training by respondents.

Vocational education in general masonry with an emphasis on residential and light commercial construction is available from two colleges within the State University of New York (SUNY) network: Alfred State College offers a 72-credit hour associate's degree and SUNY Delhi offers a 31-credit hour certificate.[79] Programs offering more generic degrees in construction administration or construction technology are more widely available. Similar opportunities are available outside of the state. However, the only college in the country offering a degree specifically in architectural stone is the American College of the Building Arts located in Savannah, Georgia.[80] Limited availability of specialized courses in masonry may explain why 75% of respondents reported spending no amount of time training for their trade through formal vocational programs.

[79] Alfred State College, "Course Catalog: Masonry," http://catalog.alfredstate.edu/current/programs/masonry/ (accessed 12 March 2016). SUNY Delhi, "Carpentry and Masonry Certificate Requirements," http://www.delhi.edu/academics/certificates/carp/requirements.php (accessed 12 March 2016).
[80] American College of the Building Arts, "Trowel," http://americancollegeofthebuildingarts.com/trowel.html (accessed 12 March 2016).

50% of respondents spent some amount of time training through apprenticeship. Registered apprenticeship (i.e. formal, government-recognized apprenticeship) in a masonry trade is available from 18 sponsors in the state.[81] Six of these sponsors are privately owned firms and one program is sponsored by the New York State Department of Corrections and Community Supervision. By far, the majority of sponsors (11) are affiliated with the Brick and Allied Craftworkers Union (BAC) which is arguably the single largest masonry training provider in the country.[82] BAC Local #1 in Long Island City operates the only registered stone masonry apprenticeship program in the state. All other providers operate bricklayer or bricklayer-plasterer programs.

Registered apprenticeships in stone masonry last three years (four for bricklayers and plasters) and include a minimum of 144 hours of classroom instruction per year for a total of 4,500 to 6,000 hours of on-the-job and classroom training.[83] When apprenticed through the BAC, the terms can include up to 720 hours or pre-job classroom instruction and 6,700 hours of on-the-job training.[84] Regardless of provider, apprenticeships typically include some training (approximately 200-400 hours) in masonry maintenance, repair, and restoration. Registered apprenticeship leads to a formal certification that can be awarded as either a time-based or competency-based qualification.

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[81] New York State Department of Labor, "Apprenticeship Sponsor List," https://labor.ny.gov/apprenticeship/sponsor/index.shtm (accessed 12 March 2016).

[82] Federal and state apprenticeship regulations are more favorable to union participation than privately-owned "open-shop" firms. Federal antitrust rules, for example, make it more difficult for multiple open-shop employers to work together to create and share the costs of apprenticeship training programs. Associated General Contractors of America, "Preparing the Next Generation of Skilled Construction Workers: A Workforce Development Plan for the 21st Century" (Arlington, VA: AGC, 2014), available at https://www.agc.org/sites/default/files/Files/Executive/2014_AGC_Workforce_Development_Plan.pdf (accessed 12 March 2016). Open-shop firms may be more likely to offer informal apprenticeships, sometimes referred to as "traditional craft training." Don Whyte, "Craft Workforce Development 2013 and Beyond: A Case for Greater Stakeholder Commitment" (Alachua, FL: National Center for Construction Education and Research, 2013), available at http://www.nccer.org/uploads/fileLibrary/Craft_WFD_2013_And_Beyond.pdf (accessed 12 March 2016).

[83] New York State Department of Labor, "Active Trades," https://labor.ny.gov/apprenticeship/general/occupations.shtm (accessed 12 March 2016).

[84] Brick and Allied Craftworkers Local 2, "Bricklayer, Mason, Plasterer," BAC Local 2, http://bac2.org/bricklayer,-mason,-plasterer (accessed 12 March 2016).

Unfortunately, neither the federal nor state Department of Labor, which administer registered apprenticeships, publish raw data for these programs. So, the number of active stone masonry apprentices in the state is unknown. Further, because the BAC serves as an "umbrella" sponsor supplying apprentice labor to individual firms, we cannot say how many firms may be employing an apprentice. The data that are available from the state, suggest that apprenticeships in masonry may be on the decline. Since 2007, the state has lost 21 bricklayer mason apprenticeship providers.[85] Possible reasons for this are discussed further below.

In New York State and vicinity, there are at least two regularly-offered short courses relevant to masonry R&R work. These include the RESTORE training program and the Historic Masonry Certification Program offered by the International Masonry Institute (IMI), a research and training establishment created by the BAC.[86] Both provide training and certification of skills similar to those tested in the NYMLSA (Section 2.2.4) and both are fairly intensive, including more than 40 hours of total training time. RESTORE's course in Masonry Conservation is only offered in New York City but the program also holds related workshops beyond the metropolitan area and in other states. The IMI's certificate program is only open to BAC members with 5 years of journey-level craftworker experience. It is regularly offered at the IMI's training center in Bowie, Maryland, and occasionally at other BAC training centers (including that at BAC Local #1 in Long Island City) and local union halls. Outside of these regularly-held short courses, workshops lasting only a few days are occasionally offered by a variety of organizations including, the Association for Preservation Technology International, Dry Stone Conservancy, IMI, Masonry Society, and Preservation Trades Network, and by manufactures like Edison Coatings and Cathedral Stone Products (JAHN mortar training).

[85] New York State Department of Labor, " Deregistered and Closed Programs for the time period of 2007-2016," https://labor.ny.gov/apprenticeship/pdfs/DeregisteredPrograms.pdf (accessed 12 March 2016).
[86] RESTORE, "RESTORE: An Overview," http://www.restoretraining.org/index.html (accessed 12 March 2016). International Masonry Institute, "Historic Masonry Certification Program," http://imiweb.org/training/historic-masonry-certification-program-hmcp/ (accessed 12 March 2016).

Only 32% of the NYMLSA sample group spent any amount of time training through short courses and workshops. This may be explained by the limited geographic availability, irregular calendar offering, and closed (union-only) accessibility of these courses. While this type of training provides a means of continuing skill development, it is not a mode of primary trade training. Short courses can increase the subsector workforce competency in R&R skills, but are not a substitute for primary trade training for new entrants to the workforce.

Informal, on-the-job training is the most common mode of skill development among the NYMLSA sample group. 83% of respondents spent some amount of time training in their trade through on-the-job training, with 75% spending one to six years training in this mode. On-the-job training may include informal apprenticeships, however, the distinction between informal and registered apprenticeships was not defined in the survey instrument (i.e. it is likely that respondents included informal apprenticeships under the prompt for apprenticeship). Unfortunately, because respondents were not asked to specify in more detail exactly how they trained on-the-job, we cannot determine the level of structured training acquired through this mode.

On-the-job training can provide a sound and viable means of primary trade training, bearing the most similarity of any of the training modes discussed above to the age-old traditional practices of apprenticeship. It can offer the advantage of providing flexibility in instructional approaches, curriculum, and scheduling that meet the needs of the both trainee and the employer. When used as a substitute for registered apprenticeship, employers can avoid the bureaucratic regulatory and administrative burdens and oversight associated with the government program.[87] Like registered apprenticeship, trainees gain experience and develop skills through actual practice while earning an income and do not bear the financial cost of the training.

[87] Whyte, "Craft Workforce Development 2013 and Beyond."

On-the-job training also presents distinct disadvantages to formal modes: Its quality can vary greatly from employer to employer. Due to its casual nature, a structured training component may be non-existent and training in this mode may amount purely to work experience. On-the-job training is often narrowly limited to the specific type of work undertaken by the employer. Instructors may not be trained and, without oversight from a regulatory body, the training delivered may reinforce poor workplace practices. On-the-job training does not typically provide the trainee with official qualifications or certifications, which may put them at a disadvantage in the workforce. Finally, this type of training is highly subject to market forces. When the industry is in recession, firms may be inclined to reduce support of their in-house training capacity in order to remain competitive. Likewise, when the workload is high, firms may emphasize productivity at the expense of skill development.

Despite its drawbacks, on-the-job training is likely to remain the most popular mode of primary skill development in the masonry trade. Ensuring quality in this type of training can be done through formalization and standardized curricula. However, formalization would require resources and expertise that most masonry contracting firms are unlikely to have in-house. In addition, program developed and operated by an individual firm are unlikely to garner recognition within the industry as a whole. Recognizing these limitations and a desire on the part of open-shop employers to offer an alternative to recognized apprenticeships, an organization called the National Center for Construction Education and Research (NCCER) developed its own training program.[88]

NCCER accredits training providers, assesses and certifies trainees and instructors, and provides standardized curricula in a variety of construction trades including masonry. The program resembles registered apprenticeship in that it take a hybrid on-the-job- and classroom (or online)-based approach to delivery of training. Like apprenticeship, NCCER certificates are available through both performance-

[88] National Center for Construction Education and Research, "About NCCER," http://www.nccer.org/new-to-nccer (accessed 12 March 2016).

and competency-based assessment of the trainee's skills. Their masonry curriculum is broken into three levels and includes modules relating to maintenance, repair, and restoration skills.[89] The quality of NCCER accredited training is increasingly recognized by both construction industry and government entities alike.[90]

The sole NCCER training and certification provider in New York State is the Empire State Chapter of the Associated Builders and Contractors (ABC) trade association (an organization formed by owners to counter the power of unions in the industry). While it does offer NCCER training in several trades, ABC does not currently offer NCCER's masonry training.[91]

While the NYMLSA sample group indicated that there is a need for more training opportunities for their trade, primary research indicates that a number of training opportunities are already available in a variety of delivery modes. It may be that respondents were unaware of these programs or that they would like to see more of a particular type of training or more training opportunities offered in their geographic area. There is certainly room for growth and an even greater variety of opportunities—there are almost no stone masonry training programs in the state and no formal on-the-job alternatives to registered apprenticeship. Creation more formal on-the-job training opportunities could offer new recruits a pathway to entry into the trades. Creating more continuing education or advanced training opportunities could address other issues raised by respondents like low skill levels within the existing workforce. Given that a large proportion of non-specialist masons also perform R&R work, training should extend to all sectors of the masonry trade to ensure that best-practices are sufficiently disseminated. At the primary trade training level, however, the problem is likely more complex.

[89] National Center for Construction Education and Research, "Masonry Curriculum," http://www.nccer.org/masonry" (accessed 12 March 2016).
[90] Whyte, "Craft Workforce Development 2013 and Beyond."
[91] Training was available from the ABC at the time the NYMLSA was conducted and one of the respondents reported being a masonry instructor for an NCCER program in the open comments section. Associated Builders and Contractors, "Craft Training," http://www.abcnys.org/en-us/education/crafttraining.aspx (accessed 12 March 2016).

Supporting additional programs for new entrants to the trades will be difficult without students to enroll.

2.3.3 Recruitment

NYMLSA respondents reported both a current shortage of skilled workers (69%) and inadequate supply of new entrants to their trade (75%). These conditions, coupled with a workforce aging trend, underscore the importance of recruiting the next generation of R&R masons. New workers are likely to come from the Millennial generation, which represents the largest share of the American workforce. According to the Pew Research Center, more than one in three American workers today was born between 1997 and 1981.[92] Yet, U.S. Census analysis shows that workers age 19-34 represent a declining share of the construction workforce, choosing jobs in other fields instead.[93]

Difficulty recruiting new entrants to the masonry trade may be attributed to several factors:

Potential workers have negative perceptions of skilled labor jobs. As NYMLSA responses suggest, potential recruits may not want jobs requiring manual labor and society may undervalue "blue collar" professions: "No one wants to work hard and/or work with their hands anymore. Blue collar workers are stigmatized as being 'lower class'." In the *Jobs Rated Almanac*, skilled labor construction industry jobs continually score among the lowest rated.[94] The most desirable-rated jobs require at least a bachelor's degree.

Cultural pressures push young people to attend college. Or, as one respondent put it, "Our society has told young people that they must be educated or fail." The construction industry has

[92] Richard Fry, "Millennials Surpass Gen Xers as the Largest Generation in U.S. Labor Force," 11 May 2016, Pew Research Center, http://www.pewresearch.org/facttank/2015/05/11/millennials-surpass-gen-xers-as-the-largest-generation-in-u-s-labor-force/ (accessed 13 March 2016).
[93] Hubert Janicki and Erika McEntarfer, "Where Did All the Construction Workers Go?" 16 October 2015, U.S. Census Bureau, http://researchmatters.blogs.census.gov/2015/10/16/where-did-all-the-construction-workers-go/ (accessed 13 March 2016).
[94] Les Krantz, *Jobs Rated Almanac* 6th ed. (Fort Lee, NJ: Barricade Books, 2002).

traditionally targeted recruitment of high school graduates who do not intend to pursue a college education.[95] According to the BLS, however, this number is shrinking. In 2014, 68.4% of high school students were enrolled in colleges or universities, up from 65% in 2002.[96] With college tuition prices at an all time high and the market flooded with degree-holding job seekers, skilled labor work should be a more popular alternative. However, potential recruits may not have had exposure to this alternative or may not be aware of the high wages and job opportunities available to skilled laborers.

Young people lack exposure to the trades. Beginning in the 1990s, American high schools largely phased out "shop class" and other manual vocational programs, replacing them with digital technology training programs and encouraging students to focus more on obtaining a four-year college degree.[97] This has effectively reduced in-school exposure to the skilled labor trades. As one survey respondent notes, "Building trades as taught as a viable employ [are] overlooked in school. It seems to be offered as a last resort for the high schooler—not as a skill." Lack of exposure to the trades may have an even greater effect on the R&R trades specialties given their niche nature (even veteran construction workers may be unaware of these specialties). Furthermore, limited training opportunities post-secondary school may be create barriers to entry into the trades. In recent years, preservation organizations have sought to increase youth engagement and exposure to the R&R trades by providing temporary work opportunities[98] and specialized high school courses[99]. While the number of participants who go on to

[95] This practice may have the effect of recruiting the lowest performing students.

[96] U.S. Department of Labor, Bureau of Labor Statistics, "College Enrollment and Work Activity of 2014 High School Graduates," 16 April 2015, http://www.bls.gov/news.release/hsgec.htm (accessed 13 March 2016).

[97] Matthew B. Crawford, *Shop Class as Soulcraft: An Inquiry into the Value of Work* (New York, Penguin Press, 2009), 11.

[98] In 2014, the National Trust for Historic Preservation launched its HOPE (Hand-On Preservation Experience) Crew program "to train thousands of young people in preservation crafts, rehabilitate hundreds of historic sites each year, and open the world of preservation to a new group of young and diverse supporters." The program connects historic sites with a network of youth corps, preservation experts, and skilled tradespeople to complete preservation projects. National Trust for Historic Preservation, "HOPE Crew - Hands-On Preservation Experience," https://savingplaces.org/hope-crew (accessed 20 March 2016).

pursue careers in the trades is unknown, these programs appear successful in raising interest and may help attract new workers.

The masonry trades fail to attract or retain women workers. This fact is reflected by the NYMLSA sample group, of which only 5% of respondents were women. In 2015, the BLS reported that only 0.7% of brick, block, and stone masons are women.[100] This figure is down from 0.9% a decade earlier, a trend which runs contrary to women's growing numbers in the workforce.[101] Women are projected to account for 51 percent of the increase in total workforce growth between 2008 and 2018.[102] Women have long been a minority in the construction industry. However, recruiting and retaining new workers from the growing pool of female job seekers may offer the masonry R&R trades a much needed boost in numbers.

While recruitment presents significant challenges, it is imperative that industry stakeholders attract new workers to fill current vacancies and take over the essential roles that the aging workforce is

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[99] Beginning with a pilot program launched a the Queens High School for Arts and Business in 1997, the World Monuments Fund, New Jersey Institute of Technology, and the New York City Department of Education have partnered to provide one of the only four-year comprehensive high school historic preservation curricula in the country. The program, which has since found a permanent home at the Williamsburg High School for Architecture and Design, provides students with training in the preservation trades and related professions such as architecture, conservation, engineering, and city planning. Kate B. Ottavino, "The Preservation Arts and Technology Curriculum at Brooklyn High School for the Arts," *CRM: The Journal of Heritage Stewardship* 3, no. 1 (Winter 2006): 84-88. World Monuments Fund, "Preservation Arts Training Williamsburg High School," https://www.wmf.org/project/preservation-arts-training-williamsburg-high-school (accessed 20 March 2016). In 2013, the Stephen T. Mather Building Arts & Craftsmanship High School opened in Manhattan as a career and technical education (CTE) high school for "hands-on skills training in the specialized building arts and landscape trades, focused on high-quality craftsmanship and historic preservation." At Mather, the Department of Education has partnered with the National Park Service to provide students with directly work-applicable training in the trades of carpentry, masonry/plastering, decorative finishes and landscape management. Students may earn certification in components of NCCER national masonry/carpentry/plastering curriculum. Stephen T. Mather Building Arts & Craftsmanship High School, "Frequently Asked Questions," http://matherhsnyc.org/FAQ.html (accessed 25 April 2016).

[100] U.S. Department of Labor, Bureau of Labor Statistics, "Annual Averages: Employed persons by detailed occupation, sex, race, and Hispanic or Latino ethnicity" Table 11, *Current Population Survey*, http://www.bls.gov/cps/tables.htm (accessed 13 March 2016).

[101] Ibid.

[102] U.S. Department of Labor, Women's Bureau, "Women in the Labor Force in 2010" http://www.dol.gov/wb/factsheets/qf-laborforce-10.htm (accessed 15 March 2016).

leaving behind. Failure to do so will stifle growth in the subsector and eventually lead to critical labor and skills gaps. Raising awareness of the availability and benefits of jobs in the masonry trades may encourage Millennials to entertain this career option as a practical alternative to a four-year degree and student debt. Improving awareness specifically of R&R specialty career options may also help attract masons working in the new building sector of the construction industry (i.e. career change). Recruitment efforts should target women as an entirely underutilized segment of the labor pool. While recruitment is an immediate concern to employers in the subsector, it should be equally important to those who care for the historic built environment. A truly comprehensive recruitment strategy would unite stakeholders from both the trades and the historic preservation community to fill current gaps and avoid long-term shortages of skilled R&R masons.[103]

2.3.4 Qualifications

While it was not the original intent of the NYMLSA to address qualifications or certification in the R&R trade specialties, the issue presented itself. Formal qualifications are essentially a statement of competency certifying that a worker possesses the relevant skills and knowledge needed to capably and effectively execute work in a given field. No widely-accepted form of qualifications certifying competency in R&R-specific skills exists for tradespeople. Along with anecdotal reports of shortages of skilled tradespeople, architects and others have suggested the need for a formal system of qualifications for the R&R trade specialties.[104] The primary rationale for instituting such a system is to provide clients and employers with a clear and expeditious means of assessing the competency of workers.

Qualifications can help the labor market function efficiently—providing information to aid potential employers in applicant screening and recruitment procedures—and can also help set and

[103] Examples of shared stakeholder engagement in the issue include the National Trust's HOPE Crew and Williamsburg High School historic preservation curriculum (see notes 98 and 99 above).
[104] H. Thomas McGrath, "Qualification Standards for the Trades?" *CRM: The Journal of Heritage Stewardship* 20, no. 12 (1997): 5-7.

maintain a high threshold for skilled work and skilled workers. As a side effect, qualifications can have other benefits to both employers and workers.

Qualifications that are reputable can benefit employers by improving public perception of their firm, thus increasing its market share. Take for example the National Institute of Automotive Service Excellence (ASE) which began certifying auto mechanics in 1972 to improve worker competency. The program has since obtained industry-wide acceptance and recognition, with over 430,000 professionals certified at two levels (Technician and Master Technician).[105] According to ASE officials, automotive repair firms reported that customers look for the ASE logo[106] on a repair facility and often inquire about the certification credentials of mechanics (indicating raised consumer awareness).[107] Businesses with a high level of commitment to the ASE program (75% of service personnel certified) are entitled to a special "Blue Seal of Excellence" recognition from ASE. ASE officials believe that this gives recognized businesses an advantage over their non-certified competitors.

Evidence from formal qualifications systems in place within some construction industry sectors suggests direct benefits to workers including increased employability, higher wages, and greater mobility. A survey conducted by the Associated General Contractors of America found that 41% of craft workers (including carpenters, bricklayers, and stone masons) who responded believed that their competency-based certification helped them obtain or retain their jobs.[108] In another example, officials from the International Association of Bridge, Structural, and Ornamental Ironworkers union estimated that certified welders earn $10,000 to $12,000 more per year than uncertified welders.[109] Union

[105] National Institute of Automotive Service Excellence, "ASE: What's in It for Motorists?" http://www.ase.com/Content/NavigationMenu/Motorists2/ASE_Articles/ASE_Whats_In_It_for_Motorists/ASE_Whats_In_It_for_Motorists.htm (accessed 5 November 2009).

[106] Repair establishments with at least one ASE technician are permitted to display the ASE logo.

[107] U.S. Government Accountability Office, *Occupational Skill Standards: Experience in Certification Systems Shows Industry Involvement to Be Key*, HRD-93-90 (Washington, DC: U.S. Government Accountability Office, 1993).

[108] GAO, *Occupational Skill Standards*, 10.

[109] Ibid.

qualification certification also facilitated mobility of welders seeking work in another state: a naval facility in Hawaii hired welders from Oregon immediately after receiving documentation that they were certified.

Qualifications may also help bridge the divide between "blue collar" manual labor and "white collar" professional work. In many professions, a college degree serves as a formal qualification. However, as discussed above, tradespeople often receive training in their occupation through informal means and there are limited opportunities for formal training in R&R-specific skills. So, qualifications of trade skills through education alone would have limited utility. Yet, tradespeople may be at a disadvantage when compared to credentialed professionals. The comments of one NYMLSA respondent are particularly insightful:

> "It seems masons without formal training and college are disadvantaged when working with professionals who don't recognize the value of their skills and experience. Likewise some masons are resistant to considering solutions based on scientific background. [There is a] need to find common ground for team based problem solving and mutual respect."

Perhaps this is more so true in the R&R subsector than elsewhere in the construction industry since work involving the delicate fabric of historic buildings requires a considerable degree of subjective decision making and coordination between professionals and tradespeople. Without qualifications for the tradesperson, the value of their skills is seemingly discounted in the hierarchy of the jobsite where their work is subjected to close supervision by certified professionals. [110] Further, the disparity between trade labor and professional domains can, as eluded to by the respondent above, promote skill gaps among tradespeople—leaving them resistant to professionals' recommendations conceived outside of what is considered trade knowledge.

[110] McGrath, "Qualification Standards for the Trades?" 6.

Proponents of qualifications for craft workers argue that current Federal historic preservation policy effectively imposes a double standard, enforcing standards for professionals but not tradespeople.[111] Noting this disparity, H. Thomas McGrath, former superintendant of the National Park Service's Historic Preservation Training Center, writes:

> Qualification standards for preservation professionals without a reciprocal standard for the preservation trades continues and perpetuates a construction site environment where continual close professional supervision of the trade worker is a requirement and we request only the "headless hand" from the craftsperson.[112]

By allowing greater decision making responsibility to be placed in the hands of workers with recognized competency, McGrath argues that formal qualifications would diminish the need for detailed specifications and reduce project costs.[113] Conversely, continuation of present job site hierarchies will do little to reverse a "blue collar" stigma which follows the building trades and negatively affects recruitment and craft pride.

Qualifications do have limitations. Their proponents may argue that qualifications have the capacity to raise standards of training and knowledge, effectively improving skill levels within a trade. This, however, may not be accurate. The British National Vocational Qualification (NVQ) system, a government/employer led system of work-based skill qualifications, is touted by some to have

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[111] The Secretary of the Interior's *Standards and Guidelines for Archeology and Historic Preservation* define the minimum education and experience required of historians, architectural historians, archaeologists, architects, and historic architects working in Federal agencies, State Historic Preservation Offices, and Certified Local Governments. "Professional Qualifications Standards," *Code of Federal Regulations*, title 36, part 61 (2006). Although these qualifications effectively ensure that minimum professional skill competencies are met in the review of a large number of government-funded projects each year, they make no provision to qualify the workers who actually put chisel to stone. The only Federal agency requiring qualification standards for these workers is the National Park Service. However, its system of "essential competencies" for historic preservation skills and crafts (i.e. carpenters, maintenance workers, masons, painters, etc.) applies only to park employees and is not compulsory for Federal reviewers, anyone employed by a state or local agencies, or anyone working a tax act or other Federally funded projects. U.S. Department of the Interior, "Essential Competencies for National Park Service Employees," http://www.nps.gov/training/npsonly/npsescom.htm (accessed 7 December 2008).

[112] McGrath, "Qualification Standards for the Trades?"

[113] Ibid.

successfully increased skill levels in building trades and other participating industries.[114] Over six and a half million NVQs have been awarded since the program's inception in 1986 and it has continuously grown in scope to include more than fifty construction trades with three levels of attainment for each trade.[115] Yet, its critics contend that an increased number of NVQ holders does not equate to increased skill levels in the working population. Instead they argue that NVQs simply certify what workers are already doing and that the qualifications, designed to certify existing workers as well as new entrants, are ones that candidates can cope with rather than ones that increase their skills.[116]

While acknowledging their limitations, qualifications for the masonry R&R subsector have potential benefits worthy of further exploration. Further, instituting a system of qualifications for the subsector may be readily attainable. As noted in Section 2.3.2, RESTORE's Masonry Conservation program and the IMI's Historic Masonry Certificate program currently offer certifiable training. These certifications can be added to project bid and specification documents to ensure that workers have attended one of these courses. While the time, cost, and, in the case of the IMI program, union-only availability may be prohibitive to some masons, these certificates offer one way to differentiate their skills from the mainstream. For those masons who already possess a high level of competency in R&R skills, organizations like the NCCER that already provide competency assessment and certification of pre-existing skills (e.g. NCCER offers crane operator, rigger, and pipeline certifications) could be tapped to develop a program for R&R masonry. While certificates are not typically considered the same as formal trade qualifications, they can be used to circumvent a more elaborate system while achieving the same

[114] The NVQ system does not include Scotland, which employs a slightly different system of qualifications meant to be more responsive to changes in the economy and in employment practices known as the Scottish Credit and Qualifications Framework (SCQF); see Scottish Qualifications Authority, "The Development of a National System of Vocational Qualifications," in *UNESCO-UNEVOC Discussion Paper Series* 2 (Bonn, Germany: UNESCO-UNEVEC, 2006), http://www.unevoc.unesco.org/publications/

[115] U.K. Office of the Qualifications and Examinations Regulator, "Facts and Figures," http://www.ofqual.gov.uk/53.aspx (accessed 14 October 2009).

[116] Irena Grugulis, "The Contribution of National Vocational Qualifications to the Growth of Skills in the UK," *British Journal of Industrial Relations* 41, no. 3 (September 2003): 457-455.

effect. Again, this sort of certification can be called for in project bid and specification documents, effectively pushing the market to comply.

2.4 Conclusion

The NYMLSA was conducted to provide quantitative data to assess the current “health” of the masonry R&R subsector and empirically evaluate anecdotal reports of skilled labor shortages. This research has shown that the subsector has difficulty enlisting sufficient numbers of qualified workers to meet demand. Respondents expect the number of projects they work on to stay the same or grow in coming years. While the sample group may be biased toward older workers, the data indicate that the subsector exhibits a workforce aging trend that is congruent with and exceeds trends in the construction industry overall. Recruitment difficulties and worker aging and retirement suggest that, if sufficient numbers of new workers are not added to the workforce, the subsector will experience significant labor shortages in coming years.

Recruitment efforts face a number of significant challenges. Manual labor is undervalued and stigmatized as "blue collar" work. Millennials represent a growing share of the workforce but lack exposure to the trades and are more likely to pursue careers in non-manual labor fields. Increasing exposure of young people to the trades and improving awareness of options and benefits in these careers is critical to removing barriers to entry into the trades, increasing subsector recruitment, and sustaining skill levels over the long-term. This responsibility should be shared by all stakeholders engaged in the preservation of the built environment. Women also represent a growing share of the workforce but are underrepresented in the subsector. Recruitment efforts should further focus on enlisting and retaining women in the trades.

This research has shown that current skill levels within the workforce surveyed are high and that these masons possess sufficient knowledge and skills to capably conduct R&R work. However, respondents expressed dissatisfaction in the skills of the labor pool and felt that there is a shortage of

skilled workers in their trade. This suggests skill gaps among masons seeking employment and a skill shortage in the subsector overall. These observations, coupled with workforce ageing and reports of insufficient training opportunities, indicate a need for more and improved training in the R&R subsector.

Of the four modes of training tested in this study, respondents spent the majority of time training informally on-the-job. Formalizing and increasing the availability of on-the-job training opportunities may improve subsector skills and provide pathways to enter the trade and certify the skills of workers. Likewise, providing more short courses and continuing education programs can help bridge skill gaps among existing workers and certify worker competencies. Architects and specifiers can ensure skill levels on projects by calling for certified workers in bid and specification documents.

A second objective of this study was to develop and test a methodology that may be applied to other trades or geographic areas. Lessons learned from the NYMLSA and recommendations for future research are presented below.

2.4.1 Limitations and Recommendations for Further Study

For the most part, the NYMLSA proved effective in providing an assessment of the "health" of the subsector and establishing a framework that can serve to inform future studies of other trades or geographical areas. In meeting this second objective, some lessons learned from administering the NYMLSA should be considered. Participation was difficult to obtain at levels necessary to achieve statistically significant results. A greater shortcoming, however, is that the survey instrument did not reach many "rank and file" workers, resulting in data (most notably age, income, and skill levels) skewed to reflect the opinions of those working at the top of organizations. Indeed, this possibility was not fully anticipated and ordinary workers were not specifically targeted by the survey distribution. Future studies should devise ways to target responses that better represent the entire workforce. Similarly, attempts should be made to reach new-immigrant and non-English-speaking portions of the workforce.

In addition to improved sampling, future studies should consider the demand side of the R&R market and conduct survey research of architects, building owners, and other clients of R&R contracting firms to better understand their experience contracting projects (indicative of labor supply issues) and their satisfaction with workforce skill levels. Future studies should also ask respondents working in the trades when they plan to retire to provide a better indicator of future shortages due to workforce aging.

2.4.2 Afterward: Labor Shortage Realized

In the years since this research was conducted, the construction industry as a whole suffered through an economic recession and has struggled to return to pre-recession workforce levels due to a labor shortage. From its peak employment in April 2006 through January 2011, construction lost nearly 2.3 million jobs.[117] By January 2016, the industry's unemployment rate declined to a 17-year low of 8.5 percent.[118] Between 2014 and 2024, construction is expected to add jobs at the second-fastest rate among U.S. industries.[119] Despite growth, business owners are struggling to fill open positions.

A recent survey of residential contractors found that although respondents plan to hire one to three skilled laborers in the next 12 months, 76% felt it will be hard to find those new employees and a further 93% expressed belief that their businesses would grow in the next 12 months if not for hiring challenges.[120] Another survey by the Associated General Contractors of America found that 86% of

[117] John P. Mullis and Brittney E. Forbes, "CES Employment Recovers in 2014," *Monthly Labor Review,* April 2015, http://www.bls.gov/opub/mlr/2015/article/ces-employment-recovers-in-2014-1.htm (accessed 20 April 2016).
[118] Associated General Contractors of America, "Construction Firms Add 18,000 Workers in January as Employment Hits Highest Level Since 2008, Unemployment Falls to 17-Year Low," 5 Feb. 2016, https://www.agc.org/news/2016/02/05/construction-firms-add-18000-workers-january-employment-hits-highest-level-2008 (accessed 20 March 2016).
[119] U.S. Department of Labor, Bureau of Labor Statistics, "Employment Projections: 2014-24," *Economic News Release*, 8 Dec. 2015, http://www.bls.gov/news.release/pdf/ecopro.pdf (accessed 20 March 2016).
[120] Marianne Cusato, "The Skilled Labor Shortage: Where is the Next Generation of Craftsman" (Golden, CO: HomeAdvisor, Feb. 2016) available at http://www.homeadvisor.com/r/wp-content/uploads/2016/02/Skilled-Labor-Report.pdf (accessed 20 March 2016).

contractors across the U.S. were struggling to fill hourly craft jobs or salaried professional positions.[121] While shortages are highest among carpenters, 52% of home builders reported a shortage of masonry subcontractors according to the National Association of Home Builders and Wells Fargo Housing Market Index.[122]

Industry analysts attribute current labor shortages to recession losses—many (primarily young) workers left construction for work in other industries and have not returned—workforce aging/retirement, declining immigration, and low numbers of new entrants to the trades.[123] The effects of the industry-wide skilled labor shortage are predictable: projects are delayed, bids prices have increased while the number of bidding contractors has declined, there is an increased reliance on subcontractors and temporary labor, employers have had to increase wages and benefits to retain and attract workers, and, most disturbingly of all, contractors have reported a negative effect on worker health and safety.[124] The effects on construction manufacturing, suppliers, and related industries are not yet known.

These recent developments not only validate many of the findings presented above, they underscore their relevance and the need for quantitative analysis to inform labor planning efforts.

[121] Associated General Contractors of America, "2015 Worker Shortage Survey Analysis" (Arlington, VA: AGC, 2015), available at https://www.agc.org/sites/default/files/Files/Communications/2015_Worker_Shortage_Survey_Analysis.pdf (accessed 20 March 2016).
[122] Paul Emrath, "Builders See Shortages of Labor and—Especially—Subcontractors," National Association of Home Builders, 3 July 2014, https://www.nahb.org/en/research/housing-economics/special-studies/builders-see-shortages-of-labor-and-especially-subcontractors-2014.aspx (accessed 20 March 2016).
[123] AGC, "2015 Worker Shortage Survey Analysis." Miles Bryan, "Construction Industry Missing Key Tool: Skilled Workers," National Public Radio, 6 Aug. 2014, http://www.npr.org/2014/08/06/338011367/construction-industry-missing-key-tool-skilled-workers (accessed 20 March 2016). Cusato, "The Skilled Labor Shortage: Where is the Next Generation of Craftsman." Whyte, "Craft Workforce Development 2013 and Beyond."
[124] Ibid., Emrath, "Builders See Shortages of Labor and—Especially—Subcontractors."

CONCLUSION

This research has shown that quantitative analysis can be applied to the existing building stock and construction industry to provide detailed information about building condition and maintenance needs as well as the ability of industry to meet these needs. Inspiration was drawn from studies conducted in the UK where planners and policy makers have used the results to inform strategic planning efforts and develop policies that address the needs of the historic built environment. Unfortunately, few data sources contain the information needed to conduct this research. This hurdle may be overcome by repurposing existing tax assessment data to study building stock attributes and, in assessing industry workforce capacities, conducting survey research. These two components help characterize supply and demand forces in the market and may be combined to form a nexus approach to market assessment.

At the outset, this research sought to empirically evaluate anecdotal evidence of a shortage of tradespeople skilled in repair and restoration of buildings. This research goal was further refined to focus on masons skilled in repair and restoration of stone masonry buildings in New York State. An inventory and condition assessment of the state's stone building stock was conducted in order to establish current and future demand for work. By analyzing tax assessment records, this research established that there are 13,639 buildings built using some form of stone masonry construction in New York State exclusive of the five boroughs comprising New York City. Of these, 8.36% currently (as of 2007) require some form of maintenance or repair intervention. An estimated additional 3,096 buildings will also require some form of intervention in the next 20 years. The condition of the building stock will decline exponentially if not addressed in a timely manner.

A survey of masons was conducted to assess the current "health" and forecast future needs of the stone masonry R&R subsector in New York State. This research found that, while skill levels in the sample group are high, there is a shortage of capably skilled workers in the subsector overall. It further

established that the subsector will experience long-term shortages due to workforce ageing and retirement if new entrants to the trades are not recruited and trained. Labor shortages, if not averted, will have a long-term impact on subsector skill levels. Demand for R&R masonry work is projected to stay at current levels or grow in coming years. To fill current vacancies and avoid long-term shortages of skilled labor the subsector must attract new entrants, including women and young people, and increase training opportunities. Further, improved public awareness about the benefits of skilled trades jobs is needed to overcome the “blue collar” stigma associated with manual work.

This research is not without its limitations. Tax assessment data in New York State are particularly robust and this may not be the case in every locality. Because this data is collected for taxation purposes, researchers attempting to repurpose it for some other use must be cognizant of bias or other limitations owing to the tax assessors' original intent, methodology, or knowledge. Researchers would also do well to test the accuracy of the data through sampling or other means, especially when utilizing qualitative or semi-quantitative data such as building condition attributes. The methodology employed for projecting the future repair needs of the building stock has also not been tested or validated.

While the methodology employed in the survey of masons is fairly rudimentary and largely sound, the data obtained are limited by the sample group. The survey instrument did not reach many “rank and file” workers, resulting in data (most notably age, income, and skill levels) skewed to reflect the characteristics of business owners. No attempt was made to reach new-immigrant and non-English-speaking portions of the workforce. Future surveys should devise ways to target responses that better represent the entire workforce. Researchers would also do well to include the demand side of the market in their research and survey architects, building owners, and other clients of trade contracting firms.

This research attempted to devise and test quantitative methods that, while intentionally confined here, can be applied to other construction trades, building materials, or geographic regions. It demonstrates that valuable data can be acquired through inexpensive and relatively simple means. Data obtained from these methods can inform strategic planning efforts and be used to develop a rational basis for policies that address the needs of the historic built environment. Quantitative methods are particularly well suited to study issues such as labor shortages that are large in scale and emanate from systemic causes. Only by measuring these issues in an empirical way can we effectively understand and address them.

The results of this and other studies adopting the methodology presented here have direct and practical applications for a variety of stakeholders. Historic preservation policy makers can use the comprehensive inventory data gathered from tax assessment records to better identify historic buildings (including buildings at risk), develop public information programs, and target preservation funding. Tax assessment data also have applications for disaster planning and researchers studying energy use in the built environment. Trades training programs and labor organizations can employ data regarding labor shortages and the maintenance and repair needs of the building stock to recruit new workers and develop informed training strategies. With this information, architects, construction managers, and other end-users of skilled labor can better plan projects to accommodate skill gaps and labor shortages. Armed with empirical evidence, advocacy organizations can more effectively lobby government agencies for resources to maintain the existing building stock and support trades (jobs) training programs.

APPENDIX A
MATERIALS FROM THE NYS OFFICE OF REAL PROPERTY SERVICES' ASSESSMENT MANUAL

A.1 ORPS Residential Construction Grade Guide

Table 10. ORPS residential construction grade guide. Reproduced from New York State Office of Real Property Services, "Assessor's Manual: Data Collection and Maintenance of Property Inventories," New York State Office of Real Property Services (Albany: NYS ORPS, 2001).

RESIDENTIAL CONSTRUCTION GRADE GUIDE

CLASS	Construction Quality	Design	Kitchen	Bathrooms	Closets	Heating & Electricity
A	Excellent materials and fine workmanship	Unique, designed by an architect	Best quality, many built-ins	Best quality, usually one per bedroom	Usually walk-in closets, with dressing room in the main bedroom, spacious in others	Best quality heating system; expensive electrical fixtures, many
B	Good workmanship and materials	Custom built to specific plans	Good quality, several built-ins	Good quality, usually one bath for each 2 bedrooms	Usually one walk-in, good storage space, more than adequate	Good quality heating system. Good electric fixtures; more than adequate
C	Average workmanship and materials	Standard plans, often mass produced	Standard quality some built-ins	Standard quality, usually 1 or 1½ baths	Average closets and storage	Standard quality heating system and electric fixtures. Adequate outlets.
D	Inferior workmanship and materials	Sketches only, cost an important consideration possibly modular	Below average quality, minimal cabinets, counter space	Economy fixtures, 1 bath	Minimum closet space, overall inadequate	Inexpensive heating system and electric fixtures. Outlets and electric service often inadequate
E	Inferior workmanship and materials	Sketches only, usually intended for seasonal use	Minimum quality, no built-ins	Minimum quality, may not have a complete 3-fixture bathroom	Minimum or none	Minimum or no heat. Electric system often inadequate

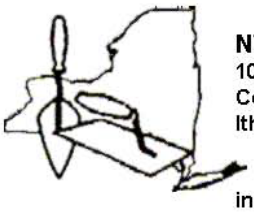
A.2 ORPS Construction Quality Codes

Table 11. ORPS Construction Quality Codes. Reproduced from New York State Office of Real Property Services, "Assessor's Manual: Data Collection and Maintenance of Property Inventories," New York State Office of Real Property Services (Albany: NYS ORPS, 2001).

CONSTRUCTION QUALITY CODE DEFINITIONS	
Economy	This is a building of less than standard construction for the commercial use occupying the structure. It typically does not have a frame and windows. Doors, floors, heating, plumbing, and electrical equipment are all low grade.
Average	This is a building of standard construction. Materials throughout will be of standard quality and utility. It typically includes masonry or non-fireproof steel framing.
Above Average	This code describes a building of superior construction and design. The frame is typically fireproof or reinforced concrete. Entrances, public areas, and elevators will be of good quality materials.

APPENDIX B
NEW YORK MASONRY LABOR AND SKILLS ASSESSMENT SURVEY

B.1 Survey Instrument and Cover Letter



NY MASONRY LABOR & SKILLS ASSESSMENT
102 West Sibley Hall
Cornell University
Ithaca, NY 14853-6701

info@maosnryskills.org
www.masonryskills.org

To whom it may concern:

You have been selected to take part in the NEW YORK MASONRY LABOR & SKILLS ASSESSMENT SURVEY. The purpose of this survey is to collect information from masons working in the State of New York in order to assess current demand and future need for training in the trade. Please take time to complete the enclosed survey and return it in the postage-paid envelope provided as soon as possible.

Participation in the survey is completely voluntary and you can skip questions that you would prefer not to answer. The responses provided will be treated as anonymous and confidential.

This survey will include questions about your job, the hours you work, how much you earn, the number of projects you work on, and the training you have received. The survey will take about 30 minutes to complete.

By participating in this study, you acknowledge that you have read and understand the statement above and agree to answer questions to the best of your ability.

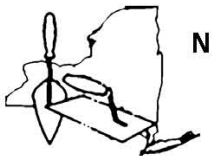
Thank you!

Sincerely,

Edward G. FitzGerald
Architecture Art & Planning
Cornell University

Please help us by spreading the word.

The researcher conducting this study is Edward G. FitzGerald. If you have questions, you may contact FitzGerald at info@masonryskills.org or (815) 715-1602. If you have any questions or concerns regarding your rights as a subject in this study, you may contact the Institutional Review Board (IRB) at 607-255-5138 or access their website at http://www.irb.cornell.edu.



NEW YORK MASONRY LABOR & SKILLS ASSESSMENT SURVEY

For more information or to complete this survey online please visit
www.masonryskills.org

PERSONAL INFORMATION

Age ❑ under 21 ❑ 21-30 ❑ 31-40 ❑ 41-50 ❑ 51-60 ❑ over 60

Gender ❑ male ❑ female

Were you born in the United States? ❑ yes ❑ no

If not, in what country were you born? _____

Ethnicity ❑ Caucasian ❑ African Am. ❑ Native Am. ❑ Hispanic/Latino ❑ Asian Am. ❑ other _____

Primary Trade Specialty (choose one)

❑ brick or block -layer ❑ banker mason ❑ fixer mason ❑ stone carver ❑ dry stone ❑ monument mason ❑ materials conservation ❑ quarrier/ supplier

Secondary Trade Specialty (choose one)

❑ brick or block -layer ❑ banker mason ❑ fixer mason ❑ stone carver ❑ dry stone ❑ monument mason ❑ materials conservation ❑ quarrier/ supplier

How many years have you worked in your trade specialty?

❑ less than 1 ❑ 1-5 ❑ 6-10 ❑ 11-15 ❑ 16-20 ❑ over 21 years

What is your annual income?

❑ Less than $30,000 ❑ $30-40,000 ❑ $40-50,000 ❑ $50-60,000 ❑ $60-70,000 ❑ More than $70,000

Which best describes your employment status in your primary trade?

❑ Full-time ❑ Part-time ❑ Seasonal ❑ Other_____

EDUCATION/TRAINING

Highest level of education completed?

❑ high school/ GED ❑ community college ❑ trade college ❑ 4-year college ❑ graduate school ❑ certificate

How much time have you spent training in the following methods in your primary trade?

	1-15 day	3-6 months	1-3 years	3-6 years
On the Job/ Informal	❑	❑	❑	❑
Apprenticeship	❑	❑	❑	❑
Formal Trade College	❑	❑	❑	❑
Short Course	❑	❑	❑	❑

At what age did you begin training in your trade?

❑ under 21 ❑ 21-30 ❑ 31-40 ❑ 41-50 ❑ over 50

How much of your time (if any) is spent training others in your trade specialty?

❑ 0-25% ❑ 25-50% ❑ 50-75% ❑ 75-100%

Do you feel your training has adequately prepared you to work with historic buildings? ❑ yes ❑ no

SKILLS

How would you rate your skill level?

❑ Laborer	❑ Apprentice	❑ Journeyman	❑ Master Craftsman
supervised worker, little/no experience	supervised worker, 1-4 yrs. experience	work unsupervised, 4-8 yrs. experience	advanced knowledge, 8 + yrs. exp.

Please rate your skills in the following areas:

	not at all knowledgeable	somewhat knowledgeable	moderately knowledgeable	very knowledgeable
Historic mortars, binding agents, etc.	❑	❑	❑	❑
Sourcing of stone to match existing	❑	❑	❑	❑
Repair philosophies and techniques	❑	❑	❑	❑
Cleaning joints/ Re-pointing	❑	❑	❑	❑
Shaping and piecing replacement masonry	❑	❑	❑	❑
Applying waterproof, water repellent, or non-historic coatings	❑	❑	❑	❑
Non-abrasive cleaning methods	❑	❑	❑	❑
Secretary of Interior's Standards for the Treatment of Historic Buildings	❑	❑	❑	❑

BUSINESS

Which best describes your business?

❑ Private Company ❑ Corporation ❑ Non-for-profit ❑ Government (Fed., State, or Local)

What is the size of your business?

❑ Independent contractor ❑ Small (1-5 people) ❑ Medium (5-25 people) ❑ Large (over 25 people)

What is your role in this business?

❑ Owner ❑ Partner ❑ Employee ❑ Trainee/Apprentice ❑ Officer (Pres.,CEO, etc.)

On what type of buildings does your business generally work?

❑ Residential ❑ Commercial ❑ Industrial ❑ Institutional ❑ Religious

Which best describes the built environment in which your business generally works?

❑ Urban ❑ Suburban ❑ Rural

What percentage of your business' work is considered historic preservation?

❑ Less than 10% ❑ 10-25% ❑ 25-50% ❑ 50-75% ❑ 75-100%

Does your business specialize in stone restoration? ❑ yes ❑ no

Where is your business located/main office (which state or territory)? _____

Where is your primary area of operation?

❑ New York State ❑ Northeastern US ❑ Nationally (US) ❑ Canada ❑ Internationally (other than CAN)

How far (miles) do you travel to do your work?

❑ Less than 100 ❑ 100-300 ❑ 300-600 ❑ 600-900 ❑ 900-1,200 ❑ More than 1,200

Does your company have an apprenticeship or training program? ❑ yes ❑ no

If yes, how many apprentices/trainees are you currently employing? _____

DEMAND

How many projects does your business work on per year?

❑ Less than 10 ❑ 10-20 ❑ 20-30 ❑ 30-40 ❑ 40-50 ❑ More than 50

In the next five years, do you expect this number to:

❑ decrease ❑ stay about the same ❑ increase

Do you have difficulty procuring the materials (specialty brick, stone, mortars, etc.) necessary to complete your projects? ❑ yes ❑ no

Are there enough skilled craftspeople in your trade to meet demand? ❑ yes ❑ no

Is there an adequate supply of new entrants into your trade? ❑ yes ❑ no

Do you think there is a need for more educational or training opportunities for masonry trades? ❑ yes ❑ no

COMMENTS

Please feel free to provide any additional comments in the space below.

THANK YOU FOR YOUR PARTICIPATION!

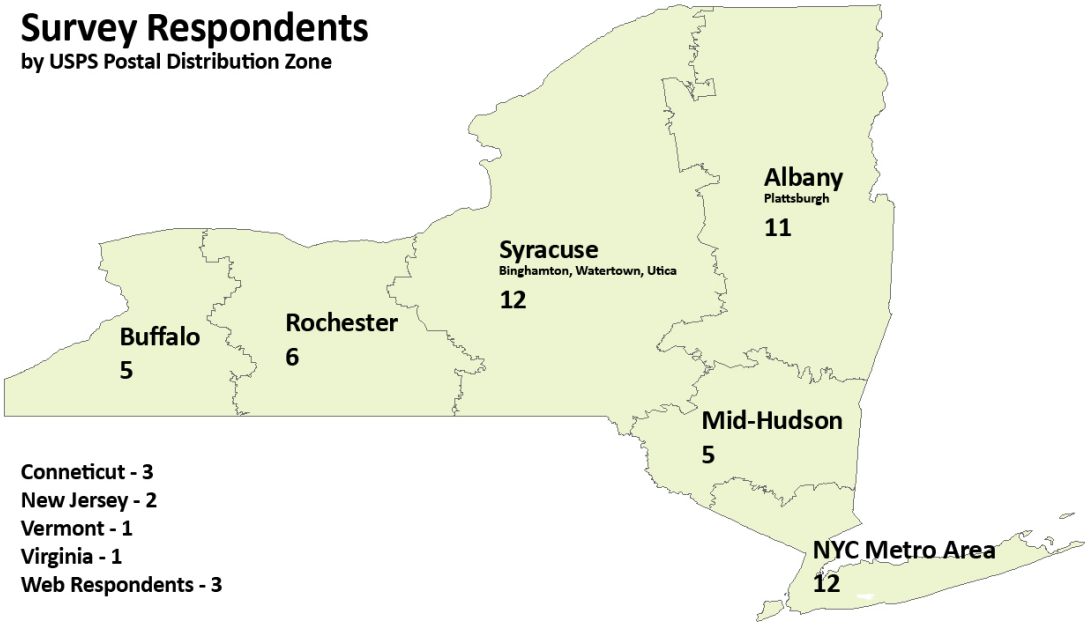
Please tell others about us, visit www.masonryskills.org or email us at info@masonryskills.org

Return completed survey (this sheet only) to:

NY ML&S Survey
Ed FitzGerald
102 West Sibley Hall
Cornell University
Ithaca, NY 14853-6701

B.2 Survey Responses

Geographic Distribution of Survey Respondents



Age

under 21	21-30	31-40	41-50	51-60	over 60	(no resp.)
1	1	13	14	26	4	1

Gender

male	female	(no response)
53	3	1

Were you born in the United States?

yes	no	(no response)
53	6	1

If no, in what country were you born?

US	Hungary	Israel	Italy	Poland	Romania	(no resp.)
54	1	1	2	1	1	0

Ethnicity

Caucasian	African Am.	Native Am.	Hisp./Latino	Asian Am.	(no resp.)
57	1	2	0	0	0

Primary Trade Specialty

brick/ block	banker mason	fixer mason	stone carver	dry stone	monument mason	materials conserv'r	quarrier/ supplier	(no resp.)
38	2	8	2	2	2	2	3	1

Secondary Trade Specialty

brick/ block	banker mason	fixer mason	stone carver	dry stone	monument mason	materials conserv'r	quarrier/ supplier	(no resp.)
6	1	16	7	3	5	4	1	17

How many years have you worked in your trade specialty?

<1	1 to 5	6 to 10	11 to 15	16 to 20	>21	(no response)
0	1	4	3	12	39	1

What is your annual income?

<$30K	$30-40K	$40-50K	$50-60K	$60-70K	>$70K	(no resp.)
2	4	7	4	5	31	7

Which best describes your employment status in your primary trade?

full-time	part-time	seasonal	other	(no response)
44	1	14	1	0

Highest level of education completed?

high school	certificate	trade college	comm. college	4-year college	graduate study	(no resp.)
18	1	8	12	14	6	1

How much time have you spent training in the following methods in your primary trade?

	1-15 days	3-6 months	1-3 years	3-6 years	(no resp.)
On the job/ Informal	2	3	14	31	10
Apprenticeship	1	4	13	12	30
Formal Trade College	4	1	6	4	45
Short Course/ Workshop	13	4	1	1	41

At what age did you begin training in your trade?

under 21	21 to 30	31 to 40	41 to 50	over 50	(no response)
41	15	2	0	0	2

How much of your time (if any) is spent training others in your trade specialty?

0 to 25%	25 to 50%	50 to 75%	75 to 100%	(no response)
34	15	4	4	3

Do you feel your training has adequately prepared you to work with historic buildings?

yes	no	(no response)
46	10	4

How would you rate your skill level?

laborer	apprentice	journeyman	master craftsman	(no response)
0	0	3	54	3

Please rate your skills in the following areas:

Knowledgeable:	not at all	somewhat	moderately	very	(no resp.)
Historic mortars, binding agents, etc.	3	13	16	28	0
Sourcing of stone to match existing	0	7	19	34	0
Repair philosophies and techniques	0	4	22	33	1
Cleaning joints/ Re-pointing	0	2	18	40	0
Shaping and piecing replacement masonry	0	8	14	38	0
Applying waterproof, water repellent, or non-historic coatings	4	9	16	30	1
Non-abrasive cleaning methods	3	13	22	22	0
Secretary of Interior's Standards for the Treatment of Historic Buildings	19	11	13	14	3

Which best describes your business?

private contractor	corporation	non-for-profit	government	(no response)
13	45	0	1	1

What is the size of your business?

independent contractor	small (1 to 5 people)	medium (5 to 25 people)	large (>25 people)	(no response)
1	17	22	18	2

What is your role in this business?

owner	partner	employee	trainee/apprentice	officer	(no resp.)
35	6	2	0	16	1

On what type of buildings does your business generally work?

residential	commercial	industrial	institutional	religious	(no resp.)
28	41	19	22	21	1

Which best describes the built environment in which your business generally works?

urban	suburban	rural	(no response)
30	30	18	2

What percentage of your business' work is considered historic preservation?

<10%	15 to 25%	25 to 50%	50 to 75%	75 to 100%	(no resp.)
29	12	11	2	5	1

Does your business specialize in stone restoration?

yes	no	(no response)
29	30	1

Where is your business located/main office (which state)?

Connecticut	New Jersey	New York	Pennsylvania	Virginia	Vermont	(no resp.)
2	2	48	1	1	1	5

Where is your primary area of operation?

NY State	NE US	national (US)	Canada	international	(no resp.)
39	16	2	0	1	2

How far (miles) do you travel to do your work?

<100	100-300	300-600	600-900	900-1200	>1200	(no resp.)
30	12	4	1	0	4	1

Does your company have an apprenticeship or training program?

yes	no	(no response)
29	30	1

If yes, how many apprentices/trainees are you currently employing?

"0"	"1"	"1 or 2"	"2"	"4"	"5"	"6"	"10"	"12"	"25"	(no resp.)
1	6	1	9	2	2	3	1	1	1	33

How many projects does your business work on per year?

<10	10 to 20	20 to 30	30 to 40	40 to 50	>50	(no resp.)
5	15	18	6	7	8	1

In the next five years, do you expect this number to:

decrease	stay the same	increase	(no response)
5	39	15	1

Do you have difficulty procuring the materials (specialty brick, stone, mortars, etc.) necessary to complete your projects?

yes	no	(no response)
5	54	1

Are there enough skilled craftspeople in your trade to meet demand?

yes	no	(no response)
18	40	2

Is there an adequate supply of new entrants into your trade?

yes	no	(no response)
14	43	3

Do you think there is a need for more educational or training opportunities for masonry trades?

yes	no	(no response)
53	4	3

Please feel free to provide any additional comments in the space below:

[Personal information omitted for privacy.]

Masonry is not just a trade, it is an art and each project is a piece of art added to the landscape.

There is a desperate need for more tradesmen. It is more serious than just a lack of training. It is a lack of desire. No one wants to work hard and/or work with their hands anymore. Blue collar workers are stigmatized as being "lower class". However that means I can charge more $, because "we" are a rarity!!

There is definitely a shortage of workers. This needs to be addressed at the high school level and it is not. I am also a teacher of masonry and concrete finishing certified through NCCER.

Very basic questionnaire. Yes there is a need for courses and formalized training. The real need is actual skilled laborers. There are plenty of people who know what to do but need the workers to do it!

I have found that through the local unions, labor is at best mediocre. The number of qualified bricklayers is at an all time low compared to the demand of construction. In addition the number of foreman is even poorer. Local unions need to mandate progressive training courses after apprenticeships are served.

Having workers in both union and non-union, the restrictions that are proposed by governmental agencies at the direction of unions will do nothing except hurt the trade. FREE TRADE is BEST.

We tried to hire and train new help but people are generally lazy. We get up at 4:15AM, work outside in cold weather—but not every day—and experience is that people don't want to do physical work. I know people hire immigrants to do hard work but we can't afford to get in trouble with the state government. So we do the work as we can— we'd love more help if we could find talented people who want to learn.

I feel most people in the business would not require college level classes but training classes are scarce and would be an improvement.

Urgent! Needs to be attacked aggressively to educate and train individual for masonry. I believe with proper education the demand will increase because it is a green product.
Building trades as taught as a viable employ is overlooked in school. It seems to be offered as a last resort for the high schooler—not as a skill.

In the last 16 years I've seen our labor pool decrease and become weaker. (Talented workers).

We have successfully, within our own company, trained approximately 15 bricklayers over the past several years, in the mason trade. This has also incorporated the training of laborers as well. And we are confident that they, in the eyes of this company as well as any company we have worked for, as some of the best in the area. What we don't need is more government or union apprenticeship programs forced upon us.

Worked primarily NY state 1985-1999, specializing in historic masonry & mortars. Took job w/ Pennsylvania Historical & Museum Commission, as Preservation Construction Specialist. I write specs, oversee contractors working on historic structures, train when required & train young adults in historic trades. We also consult for other agencies and participate in conferences & workshops. I had to design a college program w/ Empire State and earned a BA in historic preservation in 1994.

Employ. Status: "semi-retired". There is an adequate supply of journeymen advance to level of master craftsmen in terms of skill: it seems masons without formal training and college are disadvantaged when working with professionals who don't recognize the value of their skills and experience. Likewise some masons are resistant to considering solutions based on scientific background. Need to find common ground for team based problem solving and mutual respect.

We are a small union company. Definitely feel that there are not enough new apprentices and no recruitment for said apprentices. The labor force we usually get from the union halls are grossly inadequate, making it difficult to get good qualified workers.

Layout men and foremen are at a premium. Buildings are moving away from brick because of unqualified bricklayers. Preset panels are taking up as much as 25% of brick jobs. The high salary costs don't help if they can't be justified. Bricklayers look at their job as a temporary application, thus making a poor attitude toward work.

We mostly repair counter tops. 90% of the work I do is fixing other people mistakes. The NSRA (Natural Stone Restoration Alliance) has a two day class that is pack with information that is need to do this type of work, plus you get all the tools and contacts that is needed. www.nsraweb.com

The main problem with the work environment in stonemasonry is there is no respect for the value of serving a proper apprenticeship under skilled masters of the trade. It is impossible to learn a well rounded understanding of the trade in less than 15 years. Only people born into the trade in a family business are willing to do this. Our society has told young people that they must be educated or fail. Our laws don't allow young people to work anymore. When I was 10 I loaded stone on trucks. I left school in 9th grade at 15 years old. Today I command $250.00 per hour and my sons, ages 26, 28 & 30 command $180.00 per hour. We choose who we want to work for, and all our contracts are negotiated. We love our work and could not imagine doing anything else. This is impossible for the population at large to understand. Unless there are changes in how the trades are viewed socially there will be no hope in bringing back the craftsmanship that this country new when our European ancestors immigrated here. Until then I will continue to raise prices.

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